S·A·E JOURNAL

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John A. C. Warner, Secretary and General Manager

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About Authors

● Ernest J. Abbott *(M '35) is an industrial physicist working on practical industrial jobs with the aid of modern physics tools and techniques. Holding degrees in both engineering and physics from the University of Michigan, he spent a decade of work on unusual problems for various industrial concerns. Several years ago, he formed Physicists Research Co. to undertake jobs which do not respond to ordinary methods of treatment, but which can be solved by a practical combination of engineering and unusual physics tools. Results have been achieved on a variety of problems, and these have formed the basis for papers before mechanical, electrical, refrigerating, and automotive engineering societies. His SAE papers have dealt with noise reduction and surface measurement.*

● Earl Bartholomew *(M '27) received his A.B. from the University of Oklahoma in 1921. For the next two years, while working for his M.S. in M.E., which was granted in 1923, he was instructor in mechanical engineering at the University. During the period 1923-1926 he was at Harvard as instructor in mechanical engineering in the Engineering School. He joined the Ethyl Gasoline Corp. in 1926 and since 1927 has been director of its engineering laboratories.*

● Benjamin Brewster *was graduated in mechanical engineering from the Harvard Engineering School in 1927. During the next year he was employed in the engineering laboratories of Ethyl Gasoline Corp., in Yonkers, New York, and Detroit. Mr. Brewster was then sales engineer with the Holtzer-Cabot Electric Co. of Boston for several years. In 1936 he rejoined Ethyl to participate in a program of fuel research.*

● Harold J. Chalk *has been affiliated with the Ethyl Gasoline Corp. since graduating from the University of Michigan in 1929. With that company he has participated in studies relating to fuel detonation problems in single-cylinder laboratory engines and cars operated on the road.*

(Continued on page 31)

Publication Office, 56th and Chestnut Sts., Philadelphia, Pa.; Editorial and Advertising Departments at the headquarters of the Society, 29 West 39th St., New York, N. Y. Western Advertising Office, Room 2-136 General Motors Bldg., Detroit, Mich.

Government-Backed Air Transport Urged at National Aero Meeting

IF the United States is to hold its air-transport leadership in the trade routes of the world, Government backing, both legislative and financial, soon must be forthcoming, contended Juan T. Trippe, president of Pan American Airways, the principal speaker at the Banquet that closed the 1938 SAE National Aeronautic Meeting, Washington, D. C., March 10 and 11. The meeting was sponsored by the SAE and its Washington Section with the cooperation of the Aeronautical Chamber of Commerce of America and the Air Transport Association of America.

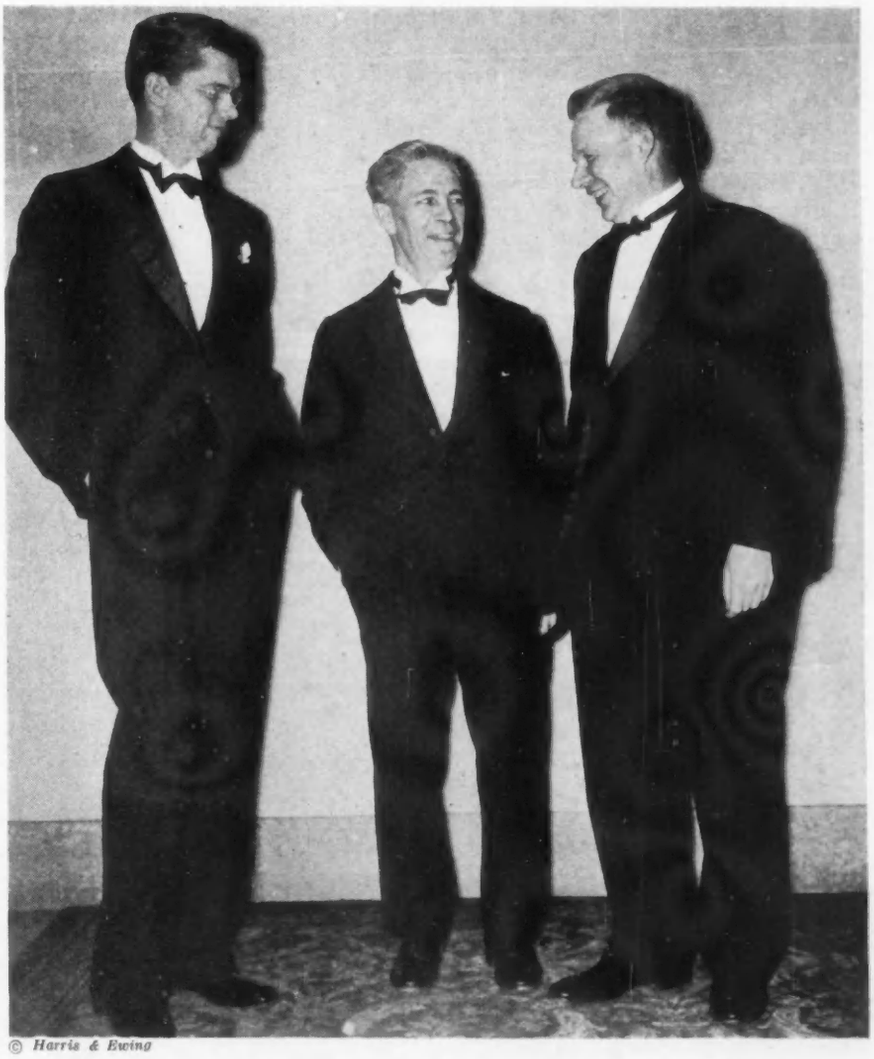
Several pages of aviation-engineering history were written in the five technical sessions that preceded the Banquet, according to many who attended, where problems that vitally affect the future of aviation were probed in 12 papers. Propeller, engine, and aircraft engineers put their heads together to try to decide what sort of a combination of these three elements would be best in the future – and whether bigger and bigger engines are really desirable. Operators' and pilots' demands for "a carburetor that will not ice" were met with assurance that such a device is not far off. Still more encouragement was given pilots at another session where the pleasant prospect of making blind landings with only one instrument to watch took definite form. Enthusiastic private flyers piled suggestion on suggestion on how to lift this branch of aviation to a level comparable to that of other nations. And, finally, as a background for the Banquet speech, the performance of large flying boats and the practical side of seaplane transportation were discussed.

Two inspection trips were held simultaneously on the last afternoon. One group traveled by bus to Baltimore to see the modern plant of the Glenn L. Martin Co. in operation. Lunch was served en route with C. S. Bruce of the Washington Section acting as the genial host. The other group was escorted through the Naval Gun Factory, and inspected the Göttingen-Type Return-Flow Wind Tunnel and the first large ship-model basin in this country.

"Today in America, alone of all nations, air transport is an orphan child. We have no permanent air legislation; to date our Government has passed it by," continued Mr. Trippe. The time has come, he pointed out, when independent American companies no longer can compete successfully with foreign national air transport systems that have the power and prestige of their governments behind them, such as Great Britain's Imperial Airways, France's "Air France," and Germany's "Deutsche Lufthansa."

Most people know the importance of America's international air service to our national defense, Mr. Trippe remarked, but they are apt to overlook its effectiveness in maintaining and building up our foreign trade – a five-billion dollar industry.

SAE Officers Prominent at Aero Meeting



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R. N. DuBois (*left*), vice-president for aircraft-engine engineering, W. F. Beasley (*center*), chairman of the Washington Section, and F. W. Caldwell, vice-president for aircraft engineering.

Concluding on a more encouraging note, Mr. Trippe reported that Federal legislation to correct the situation is pending and action is expected at this session of Congress. Mr. Trippe's speech was broadcast over a national radio network.

SAE President C. W. Spicer, in a short speech earlier in the program, contrasted the gradual year-by-year development of aircraft by engineers, using all the experience of former years, with the method of scrapping all previous experience and starting anew used by "certain politicians."

Presentation of the Manly Memorial Medal for 1937 to Richard S. Buck of Pratt and Whitney Aircraft by S. D. Heron, member of the Manly Memorial Medal Board of Award and winner of the first Manly Medal awarded in 1928, completed the Banquet program. The winning paper: "Flight-Testing with an Engine Torque Indicator," by Mr. Buck and A. Lewis MacClain, was selected as the best on aircraft powerplants to be presented before an SAE meeting in 1937. It was published in the Transactions Section of the February, 1938, issue of the SAE JOURNAL. As another previous Manly Medalist, the co-author, Mr. MacClain, was ineligible.

W. P. MacCracken, who served as toastmaster at the Banquet, was introduced by W. F. Beasley, chairman of the Washington Section of the SAE.

Engines Session

A. T. Colwell, *Chairman*

SUCCESSFUL efforts at either damping out or controlling the most offensive torsional vibrations in in-line aircraft engines were described in the first paper of this session: "Torsional Vibration in In-Line Engines," by R. M. Hazen and O. V. Montieth, Allison Engineering Co. The second paper: "Carburetor Icing," by Robert Sanders, Engineering and Research Corp., provoked pleas for "a carburetor that will not ice," from pilots and engineers alike who expressed, in no uncertain terms, their desire to do away with heating the intake air with its inefficiencies and added pilot responsibility.

Vibration Neglect Called Engineering Suicide

Practically every step in the development of the modern aircraft powerplant has tended to make the torsional-vibration problem more severe, until it is now engineering suicide to design a new engine without predetermining the torsional characteristics and providing for essential damping, pointed out Mr. Montieth who read the first paper.

The improvements in propellers, going from wood to fixed-pitch metal, then to two-position and, finally, to the completely variable-pitch propeller with gear-reduction drive, have spread greatly the full-throttle operating speed of the engine, he continued. With the addition of take-off rating, the economy of low-speed full-throttle cruising, and a dive-test requirement, the modern engine should have satisfactory torsional characteristics *at full throttle* anywhere from 1000 to 3500 r.p.m. or more, he reported. When, to cap the climax, we realize that increasing compression ratios and cylinder pressures increase vibration amplitudes, and that resonant harmonics on a four-stroke cycle engine are possible at ½, 1, 1½, 2, 2½ . . . and so on, orders of the fundamental frequency, the position of the designer becomes none too happy. But there is a favorable side of the picture, he added, as several of the harmonic orders cancel out, considerable damping exists in the engine itself, and vibration characteristics can be predetermined.

Both single-node and two-node vibrations occur in high-output in-line engines, Mr. Montieth revealed, whereas the radial engine usually encounters only the single-node type. The single-node type usually evidences itself at the propeller cone or hub where galling occurs, or in the accessories and drives when they are taken from the anti-propeller end of the shaft, he explained, whereas two-node vibration stresses

Speakers at the Banquet

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SAE President, C. W. Spicer (*left*), Juan T. Trippe, president of Pan American Airways, the principal speaker (*center*), and W. P. MacCracken, toastmaster.

Awarding the 1937 Manly Medal

Richard S. Buck (*left*) receiving the 1937 Manly Medal from S. D. Heron, member of the Manly Medal Board of Award, at the Banquet. Mr. Buck was co-author of the paper: "Flight-Testing with an Engine Torque Indicator," which was judged the best on aircraft powerplants for 1937.

the crankshaft highly at the node and excessive amplitude is evidenced chiefly in crankshaft failure. The two-node vibration of in-line engines is very similar both as to frequency and effects to the single-node type on radial engines, except that it is less likely to cause propeller troubles, he concluded.

Mr. Montieth went on to present the results of several studies and tests on twelve-cylinder in-line engines with six-throw crankshafts that included a full discussion of the torsional-vibration dampers employed.

Torsional vibration of the crankshaft is of tremendous interest not only because of its effects on the crankshaft itself and the propeller but also because of its influence on all airplane surfaces, pointed out J. H. Geisse, Bureau of Air Commerce, the first to rise in discussion.

That it appears necessary to apply correction factors, because of engine looseness in correlating observed with calculated vibration frequencies, seems to make predetermination of resonant-frequencies an art rather than a science, observed N. N. Tilley, Continental Motors Corp. Could the authors divulge how they figured these corrections?

The discrepancy discussed by Mr. Tilley does exist, but we don't know exactly why, was Mr. Montieth's frank reply. We believe, however, that the type of engine mount is more important to the correction factor than the looseness of the engine, he explained.

If the authors would separate the damping factor from the frequency effect, it would increase the value of the paper, suggested J. M. Tyler, Lycoming Division, Aviation Mfg. Corp.

Heating Air Has Drawbacks

"Heating of the intake air, the most generally used method of eliminating carburetor ice, has the serious drawback of reducing the effective octane number of the fuel used," contended Mr. Sanders in the session's second paper. "By this statement I mean," he explained, "that heating of the intake air causes higher cylinder temperatures and detonation at lower power outputs. To complicate the situation, he pointed out, the indications of carburetor ice and detonation may be confused easily so that a pilot confronted with a loss of power does not know whether he should apply heat to eliminate possible ice or reduce heat to eliminate possible detonation."

This was the chief reason for our search for a substitute for continuous application of heat to the carburetor, Mr. Sanders stated, describing the results of tests made while he was working for Pan American Grace Airways along the West Coast of South America where much of the upper air is moist and cool. We found that the key to prediction of carburetor icing was not temperature but absolute humidity, he announced, displaying carburetor ice charts that indicated the "danger zone," the "clear zone," and a "questionable zone" when dry-bulb temperatures were plotted against the difference between the dry-bulb and the wet-bulb readings.

Assuming that ice can form only when the dew point of the air is above freezing, Mr. Sanders laid down three rules aimed at eliminating or reducing carburetor ice during this weather condition: (1) operate at as lean a mixture as is consistent with other instructions, (2) maintain full cruising power, and (3) maintain as high a cruising altitude as possible. If these three precautions fail to prevent icing, heating is, of course, necessary, he concluded.

Two written discussions held that the dry- and wet-bulb measurements of the outside air obtained by Mr. Sanders might be quite different from those measured near the throttles. They were prepared by W. L. Losson, and R. E. Johnson both of Wright Aeronautical Corp. "The obvious solution of the icing problem is to use carburetors designed to eliminate ice formation caused by vaporization of the fuel," believes Mr. Losson, reporting that several hundred of such carburetors are in successful service. Giving as his principal reason the serious loss of power at take-off, Mr. Johnson registered strong disagreement with Mr. Sanders' recommendation to apply heat during take-off.

The carburetor-icing problem still requires the personal attention of the pilot; we should arrive at a solution that takes the responsibility off his hands, contended Dr. H. C. Dickinson, National Bureau of Standards whose sentiments were seconded heartily by Mr. Geisse.

A loss of as much as 150 r.p.m. with the carburetor heater on was reported by Mr. Tilley in factory tests using a mirror under the carburetor to watch the ice formation. In some engines, this loss may amount to 25 per cent of the total power, he estimated.

Discussing Mr. Sanders' paper from the pilot's viewpoint, Lieut. Com. Rice Botta, Bureau of Aeronautics, stated that it seemed to be "curative rather than preventive medicine." With the increased tendency toward icing that comes with higher boosts, we need, more than ever, a carburetor that will not ice, he contended.

Answering Lieut. Com. Botta's plea, F. C. Mock, Bendix Products Corp., reported that such a carburetor was "in close sight," as was also a method of making impossible the presence of impact ice in the carburetor.

(*Continued on page* 26)

Your Society

The President

THIS is the second article of a series on "Your Society."

This series aims to bring alive every phase of Society functioning as related to the individual member.

Philip H. Smith, contributing editor to *Scientific American*, was chosen by the Publication Committee to analyze the Society's functioning and to interpret it as it appeared to an informed outsider.

THE presidency of your Society is an honor. It is also a working job. What the average member sees is not the round of labor, but the new face every year; what he hears is not the thoughtful discussion which goes into the making of fruitful policies, but a few addresses. There is a behind-the-scenes to this office and to most people it is a mystery.

Just what does the president do? Why have a president anyway? Perhaps these questions are never formulated definitely in the minds of members, but some do wonder what a president does to keep busy, and the questions are fair.

Let us dismiss at the outset any idea that the president is paid for his services. The only money that ever finds its way into his hands, reimburses him for traveling expenses to and from meetings. The president works for the opportunity to do a constructive job.

It is not quite so simple to tell just what the president's job is. And the reason for this is that every incumbent has his own idea of what he can do, how to do it, and how much time to spend at it. There is no limit to the amount of time he can spend filling the office, but there is a minimum. That minimum is the time required to perform routine functions. It is his duty, for instance, to approve the budget and plan of operation. He must also make the appointments for various committees, and review and revise personnel lists, and approve them before confirmation. At the business session, held at the time of the Annual Meeting, the president must preside and during the busy season he usually holds a meeting with the Council every month. Presidents are apt to be hazy as to just how much time the office requires. Offhand, they say one month, but if you ask them to pause and figure closely they discover that three months is a closer estimate.

A great time-consumer is the annual visit to the Sections. This one duty may take over a month in the aggregate. It calls for thousands of miles of travel packed into a few weeks; it requires seeing and talking with a great number of people; it demands concentrated thought. All of this is a lot to ask of any man who has a business connection, but it is a logical pursuit for a president. It brings him to all the Society and it brings all the Society, with its manifold viewpoints, to him. This is where the president does his knitting because he acts to knit the Society together in a way that no other officer could do. Not being a paid functionary, he brings inspiration and a detached viewpoint, rather than office mechanics, to bear upon problems. He is the symbol of the Society just as surely as is the Crown the symbol of the British Empire.

It is the functions which are not routinized (and visiting the Sections may be included) which reveal fair, good and excellent presidents. Here is where vision is brought to the job and it is quite all right to discuss such an intangible as vision because the results of it can be discerned, if not at the moment, then certainly in retrospect.

The incoming president has been on the firing line of

On the left are the Presidents of the SAE, photographed at approximately the time they held office. They are:

1 – A. L. Riker[1] ..... 1905 to 1907
2 – T. J. Fay 1908
3 – Henry Hess[1] 1909
4 – H. E. Coffin[1] 1910
5 – Henry Souther[1] 1911
6 – H. F. Donaldson[1] 1912
7 – H. W. Alden ..... 1912 and 1923
8 – Howard Marmon 1913
9 – H. M. Leland[1] 1914
10 – W. H. Vandervoort[1] 1915
11 – Russell Huff[1] 1916
12 – G. W. Dunham 1917
13 – C. F. Kettering 1918
14 – C. M. Manly[1] 1919
15 – J. G. Vincent 1920
16 – David Beecroft 1921
17 – B. B. Bachman 1922
18 – H. M. Crane 1924
19 – H. L. Horning[1] 1925
20 – T. J. Litle, Jr. 1926
21 – J. H. Hunt 1927
22 – W. G. Wall 1928
23 – W. R. Strickland 1929
24 – E. P. Warner 1930
25 – Vincent Bendix 1931
26 – A. J. Scaife 1932
27 – H. C. Dickinson 1933
28 – D. G. Roos 1934
29 – W. B. Stout 1935
30 – R. R. Teetor 1936
31 – H. T. Woolson 1937
32 – C. W. Spicer 1938

[1] Deceased.

industry; he has had as well some experience in the workings of the Society through activity on committees or the Council, and what a president should be and does is not a mystery to him. Usually he has some plans or policies as a result of association in Society operations and industry, which he thinks will make the Society of greater value to its members. This is his vision and his personal contribution.

While the president is the active head and may be an initiator of policies, this does not mean that any policy that he advocates will be certain to be put in force. He is a leader only, not a ruler. His policies must run the gauntlet of the Council and he must accept its verdict. The Council's inquisition serves to bring to light the weaknesses and strengths of his ideas so that policies must ride on their own merit.

Personality Stamped on Office

The president stamps his personality upon the office as long as he holds it. He may be a good parliamentarian, an aggressive fighter, a fuss-pot, or a showman; whatever he is, is reflected to some degree in the character of Society work for the year in which he serves. He is the head and no mere dignitary.

There is sound purpose in stressing the fact that the presidency is a working office. We can all think of some organization where the president is not a worker, but a rubber-stamp; where his sole appearance is on a platform extending stereotyped greetings once a year while the real work and policy-making functions are performed off-stage by someone else. Such organizations are not uncommon and are often quite successful, but they are less democratic in form and subject to internal disintegration. In your Society the annual injection of new blood raises the blood-pressure of the entire organization and acts to give a new vitality to its purpose. Given an active and unremunerated head, the Society cannot lose sight of its objective.

Still the question may be asked, "Is it wise to change the president every year?" Perhaps twelve months does not give sufficient time for the office to accomplish its purpose. We used to hear this said about the presidency of the country, and a similar disadvantage might apply here. Perhaps an adequate answer would be to say that no president desires so radical a change in the affairs of the Society that a year is too brief an interval for its accomplishment. If he cannot see his aims carried through to completion while in office he can at least sow the seed and fertilize it so that it will live by its own vitality.

Given a working office, a one-year limit to the term is almost imperative. Men of highest caliber are sought and men of this type cannot afford to give more than one year of their time and energy to Society affairs.

It is significant that most presidents have held some office in the Society before coming to the Chair, and that they continue in close association by sitting on the Council for two years after office. It means that your presidents have not been towel-counters, as a little story will explain:

When a promising young man was approached to take the helm of a large educational institution, he was filled with a large and consuming uneasiness. Thinking to get comfort and light, he called upon an older and more experienced friend, and, upon stating his doubts, received this reply:

"You'll make out all right, Charlie, if you'll let somebody else take the responsibility for counting the towels."

Incoming presidents know that the towels don't need to be counted; that the mechanism of operation is such that affairs will keep going smoothly without watching details. The continuity of office really serves a dual purpose because, besides acquainting him with operating mechanisms, it enables him to contribute guidance after office. In short, the president begins to function with a running start, and when his year is up, his contribution is tapered off rather than cut off. There is plenty of time and opportunity, therefore, for aims to be accomplished.

"Yearly injection" is more than a phrase. Anyone at all conversant with the work of the Society, who has seen its operations broaden and felt the surge of its vitality, will understand its true significance. Run down the list of past-presidents and the major contribution of each will come to mind. One is known for making aviation a more active branch of Society endeavor; another brought research into prominence; still another made more of standards activity, and so on. It is not easy to assign achievement to specific men, yet we can all recognize what it is that has been left behind long after the men have departed from office.

If you should ask ten past-presidents what contribution a president can make to the Society, you would get ten different replies, but you would note a common thread running through them all. You would hear that the president is a key-noter, that he is the one to bring into the Society an understanding of the outside industrial world which the Society aims to serve, or that it is his duty to inject new vision into its operations. "Sitting on the lid to keep things from going wrong," said one president, yet his contribution was more positive than he phrased it. There is truth in all their statements, because all the contributions have been made. But let us work back to this matter of what a president does by seeing how he comes to be elected; how a choice is made.

The nominating committee is composed of 25 men. There are three members at large, elected by members present at the business session of the Annual Meeting, and 22 men coming from the Sections. Each Section elects one of its members to represent it on the committee, and for safety's sake two alternates are chosen at the same time.

This selection of a member to sit on the nominating committee is the first step toward picking a president. It even begins the determination of the caliber of president that will be chosen, because the better the nominating committee the better the selection. The delegates thus chosen assemble at the time of the Annual Meeting and the nominating begins.

Choosing a President

When the nominating committee has been rounded up and called to order by the temporary Chairman – the delegate at large of longest membership in the Society who happens to be present – each delegate hands in his credentials and the way is open to present the names of candidates. In presenting a name, the delegate states why he thinks the person would be desirable, but if the statement is not convincing, many questions may be asked. For instance, what has the person done to distinguish himself? The purpose of this question is not to weed out the less well-known, but to determine what the man's capacities may be which would make him suitable presidential timber. Another question that might be asked is, "What has he done to further the work of the Society?" Has he labored on any of the committees? If the person championed has hitherto not functioned in any way in Society activities, a delegate may ask for evidence to show what reason there is to think that he will manifest exceptional interest and understanding of the Society in the future.

By the time a nominee's name has been subjected to the sharpshooting of the committee, every member will have a pretty good idea of the man in question. If the nominating delegate has any illusions regarding the man he brings forward, they are likely to be destroyed in meeting. On each ballot the stragglers are lopped off, and final decision comes down to basing on fine points.

The considerations which have weighed most heavily in the ultimate choice relate to matters wholly to the best in-

terests of the Society, quite apart from personality. Delegates seem to have agreed that the man to be chosen must be able to pitch in and do quickly what most needs to be done. The part of the country the nominee hails from also is considered. It has been thought undesirable for all presidents to come from a single city or area, even though it may be representative of a large proportion of Society membership. What are the nominee's connections? Does he represent passenger cars, trucks, aircraft, engines, tractors, or what? Perhaps a particular branch of Society activities needs strengthening more than the others and a man conversant with the problems and operations of that branch will be the more desirable choice, other things being equal. When a working president is being sought, nominating committees have usually thought it logical to find what the man can bring to the Society, regardless of what the Society brings to the man in honors.

Part of the idea of injecting new blood, already referred to, relates to this matter of picking men from different branches of the engineering profession, so that every phase of the Society's activities will get a fair hearing and an adequate drive behind it. Pushing on one salient after another makes for a lively Society just as it produces an aggressive war.

What the Society has aimed to get is men of broad vision, to steer, to guide, and to "paint the big picture" in the finest sense of the phrase. It has succeeded when the nominating committee was well chosen and took its duties seriously. And the man chosen succeeds when you, the member, tell him what you want.

SAE *Coming* EVENTS

Baltimore – April 7

Pythian Bldg.; 8:00 P.M. Motor Tune-Up Clinic.

Buffalo – April 4

Hotel Statler; dinner 6:30 P.M. High-Speed Photography – H. H. Scott, General Radio Corp.

Canadian – April 28

Regional Meeting in Windsor, Ontario.

Chicago – April 7

Regional Meeting in Hammond, Ind. There will be afternoon inspections of the Wisconsin Steel Works and the Great Lakes Ore Carrier of the International Harvester Co.; dinner 6:00 P.M. at Phil Schmidt's, in Hammond, Ind. B. F. Courtright, superintendent of metallurgy and inspection, Wisconsin Steel Works, International Harvester Co., will talk on Quality Control in Steel Manufacture.

Cleveland – April 11 and April 28-29

April 11 – Cleveland Club; dinner 6:30 P.M. American and Foreign Military and Commercial Aircraft – R. V. Kerley, assistant mechanical engineer, U. S. Army Air Corps.

April 28-29 – Hotel Statler. Sectional Regional Transportation and Maintenance Meeting. There will be morning, afternoon and evening sessions, with the "Utilities Dinner" at 6:30 P.M., Thursday, April 28. (*For program see page 23.*)

Dayton – No Meeting

Detroit – April 11

Statler Hotel; meeting 8:00 P.M. Symposium on the General Principles of Heat Transmission. R. N. Janeway, head of the Dynamics Research Department, Chrysler Corp., will treat the subject from the standpoint of engine application; J. Henkel, experimental engineer, Chrysler Corp., will talk on subject from the standpoint of cooling systems.

Indiana – April 12

Purdue University, West Lafayette, Ind. Joint meeting of the Indiana Section and the Student Branch at Purdue University, the latter acting as host to the Section. There will be afternoon and evening sessions at the University, with a dinner at 6:15 P.M. in Memorial Union Ballroom. C. W. Spicer, vice-president, Spicer Mfg. Corp., and president of the SAE, will talk on New Firing Lines for Engineers. John A. C. Warner, secretary and general manager of the SAE, will talk on Truth Through Torture.

National Tractor Meeting

April 14-15 Milwaukee, Wis.
Schroeder Hotel
(See page 22)

Section Regional Transportation and Maintenance Meeting

(Public Utility Operations)
April 28-29 Cleveland, Ohio
Hotel Statler
(See page 23)

Summer Meeting

June 12-17
White Sulphur Springs, W. Va.
The Greenbrier

Kansas City – May 6

Hotel Kansas Citian; meeting 8:00 P.M. Debate between engineering students of the University of Kansas and Kansas State College. Subject – Resolved That the Compression Ignition Type of Engine Is More Desirable Than the Spark Ignition Type Engine for Automotive Equipment. Dr. Earl D. Hay, assistant dean of engineering, will take charge of arrangements for the University of Kansas, the team of which will argue in the affirmative, and Prof. Linn Headlander, head of the Department of Mechanical Engineering, Kansas State College, will take care of arrangements for his College, the team of which will argue in the negative. A series of short automotive films will be shown during the period of decision by the judges.

Metropolitan – April 12

Wright Aeronautical Corp. plant, Paterson, N. J. Inspection of Testing Laboratories and other departments will take place from 3:00 to 5:00 P.M. Dinner will be served at 6:00 P.M. at the Alexander Hamilton Hotel, Paterson, followed by addresses by A. W. Pope, Jr., research engineer, Waukesha Motor Co., on Single Cylinder Engines for Cooperative Research; and A. L. Beall, research engineer, Wright Aeronautical Corp., on Development of Spark Plug Test Methods.

Milwaukee – April 14-15

Schroeder Hotel. The Section will participate in the National Tractor Meeting of the Society. (*For program see page 22.*)

New England – April 12

Walker Memorial, Massachusetts Institute of Technology, Cambridge, Mass.; dinner 6:30 P.M.

Northern California – April 12

Engineers Club, San Francisco; dinner 6:30 P.M. Actual Tests of Oil Filters, Oil Coolers and Air Cleaners in Field and Laboratory – Allen T. McDonald, research engineer, Caterpillar Tractor Co.

Northwest – April 22

New Washington Hotel, Seattle; dinner 6:30 P.M. Truck Maintenance – Oscar M. Brede, director of service, General Motors Truck & Coach Div., Yellow Truck & Coach Mfg. Co.

Philadelphia – April 13

Engineers Club; dinner 6:30 P.M. Grade Ability for Trucks – Merrill C. Horine, sales promotion manager, Mack Manufacturing Corp.

Pittsburgh – April 11

Webster Hall; dinner 6:30 P.M. Reduction of Piston Ring and Cylinder Wear – Macy O. Teetor, in charge of research engineering, Perfect Circle Co. Modern Gasoline Carburetion – Frank C. Mock, vice-president, carburetor engineering, Bendix Products Corp.

St. Louis – April 1

Coronada Hotel; dinner 6:30 P.M.

Southern California – April 15

Hollywood Athletic Club, Los Angeles; dinner 6:30 P.M. Aircraft Radio Accessories – D. Wright, Bendix Products Corp.; Installation of Aircraft Accessories – John Young, North American Aircraft; Aircraft Accessories – J. P. Johnson, vice-president, Pump Engineering Service Corp.

Southern New England – April 6

Bond Hotel, Hartford, Conn.; dinner 6:30 P.M. Flight Testing – Paul S. Baker, Chance Vought Aircraft Division, United Aircraft Corp.

Syracuse – No Meeting

Washington – April 12

Cosmos Club; Washington, D. C. Subject – Diesel Fuel.

News of the Society

Adequate Motor-Fuel Supply for 24,000 Years Forecast by Egloff

● Chicago

IF you and Joe Zilch have been thinking of laying up the car because of worry about an impending motor-fuel shortage in this country, you're worrying to no purpose. You and Joe can feel perfectly free to hop in the old bus and start going places without the slightest concern about the amount of gas the old boiler consumes, because there's plenty of fuel ahead based on present known motor-fuel sources. In fact, ahead lies a fuel reserve period of nothing less than 20 years based on natural petroleum deposits now in sight, and what's more, estimating fuel supply from all natural and synthetic sources capable of utilization through the most advanced processes now in use and likely to follow, there looms ahead a supply good for just a mere span of 24,000 years.

Briefly, that was the comforting message which Dr. Gustav Egloff, director of research for the Universal Oil Products Co., Chicago, brought to over 200 members and guests of the Chicago Section in an instructive address on Feb. 8. Dr. Egloff, introduced by William H. Hubner, technical chairman, said this estimate of motor fuel reserves is based on present yearly demand of 22 billion gal. of fuel for the 30,000,000 motor-vehicles now operating in this country. Analyzing newer sources of motor fuel, he discussed in turn the various motor-fuel sources such as crude oil, natural gas, cracked gases, coal, oil shale, plants and wood, and addition compounds for higher octane numbers of fuels.

The supply estimates cited are for motor fuel of normal octane rating, stated Dr. Egloff, but today when octane requirements of motor-vehicles are mounting higher this injects a new angle to the fuel production problem. Time was when an octane rating of less than 50 was acceptable to motor fuel users, but now with higher engine compression ratios the average octane rating is 70 and an octane rating of 100 is regarded as the standard requirement for aviation service.

Gasolines derived from crude oils by direct distillation range in antiknock value from about 15 to over 70 octane, with an average octane rating of about 53, the speaker declared. He pointed out that cracked gasolines vary in octane rating from 65 to 80, with an average of about 70. The cracking process, he estimated, is conserving over 1,300,000,000 bbl. of crude oil per year. Gases containing olefin hydrocarbons are produced as a by-product of the cracking process. These gases are converted catalytically into polymer gasoline and iso-octane motor fuels.

Polymer gasoline produced by the high-temperature, high-pressure cracking of propane and butanes has an antiknock value of 73 to 80 octane number; that produced by the catalytic polymerization of gaseous olefins has an 81 to 82 octane rating, Dr. Egloff stated. When the butenes are selectively catalyzed into iso-octenes and then hydrogenated to iso-octanes, the antiknock value is increased to 95 to 100 octane. Some ethers have high antiknock properties, particularly iso-propyl ether with a rating of 98-99 octane. Diesel fuels of the proper characteristics for the various speed classes can be produced by direct distillation of crude oils and in some cases by cracking, it was asserted by the speaker.

In discussing coal as a source of motor fuel, Dr. Egloff cited the experience of England where the military value of home-controlled fuel sources is a primary consideration, economic considerations being secondary. One English plant, he said, costing $27,000,000 is now producing 1,000 bbl. of gasoline per day from Wales bituminous coal through the hydrogenation method. The plant's daily production costs about 20 cents per gal., yet is equivalent to only two per cent of the motor-fuel demand of Great Britain as against the normal yearly increase in that country's motor fuel demand of fully 8 per cent.

Analyzing natural gas as a motor-fuel source, Dr. Egloff pointed out that there are 2,000 billion cu. ft. of natural gas produced yearly, and from this source, he estimated that 55 billion gal. of liquefied natural gas might be produced for motor-fuel use. As another possible fuel source, he cited alcohol from plants and wood, enormous potential reserves of which are available in this country. Such fuel sources are being utilized in England, Germany, Czechoslovakia and elsewhere as a blending agent. However, he pointed out, results from this type of motor-fuel have so far proved unsatisfactory as compared with motor performance on fuel from natural-gasoline sources.

As another source, oil-shale deposits were discussed by the speaker, who estimated that 100 years of motor-fuel supply are available in known deposits in this country when and if desired. The use of cotton seed oil was likewise cited as a possible source through use of cracking processes, an example being the case of a Chinese plant planning 250 bbl. of motor fuel daily from cotton seed oil. In evaluating future fuel sources, Dr. Egloff laid particular stress on the possibilities now opening up in the solvent extraction method. This method has been developed recently to the point where it provides a means of augmenting the supply of high octane gasoline for airplane and other uses, he declared.

Following Dr. Egloff's address, interesting prepared discussions were presented. W. G. Ainsley, Sinclair Refining Co., talked on the advances being made in engineering-laboratory test methods in checking motor-fuel performance. Cary Wagner, Pure Oil Co., in discussing the growing demand for aviation fuel of 100 octane rating indicated that fractionation of straight run gasoline to produce a product of 75 to 85 octane seems entirely feasible and with the addition of tetraethyl lead such a fuel could be raised to 100 octane or higher. Work on aromatic hydrocarbons now under way shows promising results, he declared, and if results from a 50-bbl. pilot plant are satisfactory, construction of a plant to produce 5,000,000 to 10,000,000 gal. of pure aromatics per year will doubtless be projected.

Commenting on sources for aviation fuels of high-octane rating other than crude petroleum sources, with particular application to commercial air line service, Dr. D. P. Barnard, Standard Oil Co., pointed out that iso-octane possesses as high an energy content as can be obtained for a hydrocarbon of its volatility, but since it is a chemical which must be synthesized from raw materials having different chemical structures, the production cost is several times that of the gasoline-type fuel. Blending of synthetic materials with conventional gasoline, he declared, provides fuels of higher octane number ratings at increased cost. This higher cost in the process of raising fuel to 89 to 99 octane rating runs approximately 0.9 cent per octane number as compared with 0.14 cent in the conventional gasoline range. Extension to the range up to 103 or 104 octane number by the motor method raises cost to 1.8 cents per octane number per gal. This latter value closely approaches the optimistic estimated increase in gross earning capacity in air-line service of 2.2 cents per octane number per gal. Dr. Barnard's discussion was illustrated by slides.

W. A. Parrish, Buda Co., discussed Diesel-engine fuels and pointed out the very definite need for uniformity in Diesel-fuel characteristics so that a fuel of uniform rating could be obtainable in all parts of the country. L. B. Sperry, International Harvester Co., analyzing fuel difficulties for agricultural tractors, stressed the urgent need for a more uniform fuel in a specification range which could be supplied to tractor users everywhere.

Prof. H. M. Jacklin and the following members of the Student Branch at Purdue University – M. R. Clapp, N. K. Reinhard, J. M. Diener, C. E. Dixon, and F. L. Coers – were guests of the Section at this meeting.

Transportation's March Of Progress Portrayed

● Baltimore

Four hundred and some years ago when Mother Shipston predicted the automobile, steamship, aeroplane, submarine and modern systems of communication, Englishmen doubted and called her a witch. A couple of hundred years later there were only six stage coaches in the entire United Kingdom and people were prejudiced against them "because only the rich could ride." Then, in 1802, John Gray was to be tried for lunacy because he was writing and talking about steam superseding horses. Fortunately for Mr. Gray a steam locomotive appeared pulling 10 tons at 6 m.p.h. over the Methyr Tramway while he was waiting trial and he was released.

In our own country only 55 years ago – in 1873 – a covered wagon train drawn by oxen was on the road for 5 weeks and 4 days carrying 31 families 955 miles from Dubuque, Iowa, to Colorado Springs.

These highlights in the "March of Progress in the Development of Transportation" were brought to the Baltimore Section at its March 3 meeting by Pierre Schon, transportation engineer, General Motors Truck & Coach.

Tracing the development of the motor truck, Mr. Schon spoke of the early use of the cab-over-engine design; its abandonment by all but one American company, and its recent revival largely brought about by motor-vehicle legislation restricting the size and weight of trucks. To show the decided upward trend in favor of the cab-over-engine design he quoted figures showing that factory sales of C.O.E. trucks increased from 4157 in 1936 to 10,937 in 1937, a gain of 163 per cent.

Picturing progress in the tire industry Mr. Schon made some interesting computations to show that back in 1907 the hourly wage of a tire worker would enable him to purchase 8¾ miles of tire wear, whereas in 1937 he could purchase 781 miles of tire wear with his remuneration from an hour of work. Small passenger-car tires cost about $30 each in 1907 and gave 3500 miles of wear; in 1937 they cost about $10 and were good for 25,000 miles, he said.

The author likewise showed that gasoline cost, including tax, decreased 36.8 per cent from 1920 to 1935, adding: "Considering the great improvements in engine design, more power and more miles per gallon of gasoline, the total economies in the cost for fuel effected during this 15-year period can be safely estimated at 50 per cent, regardless of an average increase in the gasoline tax of over 5000 per cent." The figures he used showed the tax in 1920 to be 54 cents for 600 gal. of gasoline as compared to $31.74 for the same quantity in 1935.

Speaking of legislation Mr. Schon stated that: "A most vigorous campaign of propaganda has been directed against highway transport, resulting in regulatory acts such as the notorious Texas law where a truck is limited to 7000 lb. payload if it passes more than one railroad station, but is allowed 14,000 lb. payload if bringing freight to the railroad depot."

He noted, however, 1937 legislative activities of the 43 states which were in regular session were in most instances favorable to the trucking industry and that with only 9 states convening for regular sessions in 1938 no drastic anti-truck bills are pending on the state legislative calendars. "As a matter of fact," he said, "in several southern states bills are pending for more liberal weight laws."

Mr. Schon indicated that all is not clear by stating: "There has been considerable agitation for a new type of regulation which, if enacted on the basis as proposed by certain anti-truck propagandists, would positively wreck the entire trucking industry. I am referring to the 'Legal Performance Requirement,' also known as the 'grade ability' proposal which would require a loaded truck to climb a certain grade at a speed of 20 m.p.h. There is no difference of opinion on the 20 m.p.h. speed, but the joker is in the per cent of grade, ranging from 3 to 6 per cent." Regarding this he asked, "Are the truck operators aware of the fact that a 5 or 6 per cent grade-ability regulation will reduce payloads 1/3 to 1/2 on a large number of present vehicles, and actually prohibit the use of all tractor semi-trailers and other combinations?"

Application of Sealing Piston Rings Discussed

● Tulsa Group

Speaking particularly on piston-ring problems of the larger types of slow-speed gas and Diesel engines, William S. Baker, inventor of the lug-type two-piece and one-piece double-seal piston-rings and sales representative of the Double Seal Ring Co., addressed the Tulsa Group on March 11.

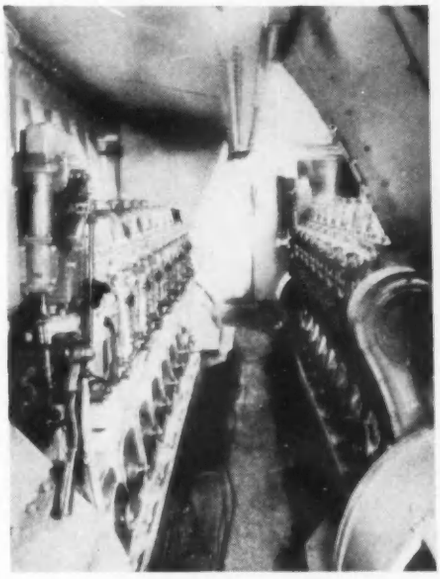
He stated that the installation of sealing rings in upper grooves of pistons in these engines will increase the efficiency of machines which may have formerly been equipped with all plain rings, or even with plain rings above sealing rings. The author explained that the question of piston-ring design, installation and function, to those who have given the subject much thought and have used sealing rings on the upper grooves, is as follows:

"Heat in excess of that to which pistons and rings would be subjected in any type machine under normal operating conditions is greatly increased by gas friction through leaky piston rings. This blowby also acts to keep lubricating oil blown away from the bearing surfaces that are in greatest need of lubrication, the upper rings and head end of cylinders. With lubrication destroyed by these forces a metal-to-metal contact between rings and cylinder wall is inevitable. It is obvious that, to attempt to evade excessive wear under such conditions by experimenting with lubrication or employing materials of various analysis for rings or cylinders, would not be successful.

"The most effective remedy yet discovered is to stop blowby with the first three rings. This will reduce ring and piston operating temperatures to near the designing engineer's calculation and, instead of lubrication being destroyed by heat and blowby, lubricating oil surrounded by temperatures below the excessive evaporating point will flow to even the top ring and remain undisturbed to lubricate rings and cylinder liners.

"Bear in mind the fact that the load which may be successfully carried on a bearing surface thoroughly lubricated is almost unlimited. With sufficient lubrication, even where ring pressure is believed to be excessive, ring and cylinder wear can be greatly reduced."

Mr. Baker noted, however, that experience had indicated that it is not practicable to use sealing rings in small-bore, high-speed gasoline, natural-gas or oil engines. "Engine builders and piston ring manufacturers," he said, "have spent much time and money in an effort to



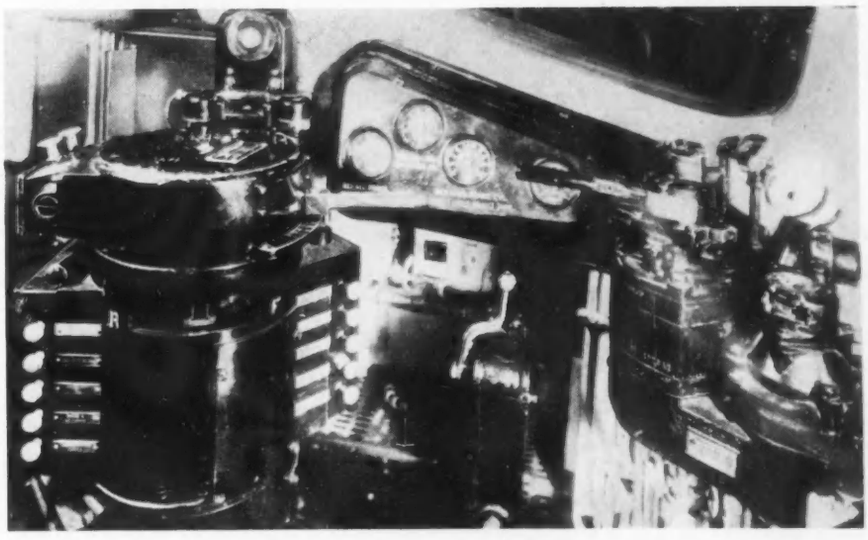
A Streamliner's Engine Room

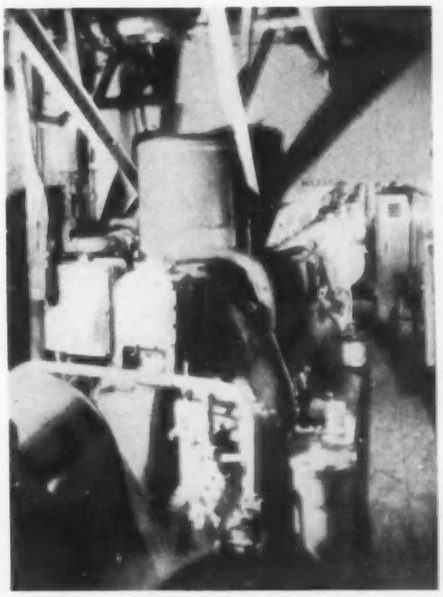
● So. California

These pictures, taken in the engine room of the Diesel-Electric train, *City of Los Angeles*, were among those used by H. L. Weinberg, electrical equipment design engineer, Union Pacific Railroad, in illustrating his talk before the Southern California Section's Truck, Bus and Railcar Meeting, Feb. 11.

They show, *top*, auxiliary power units as mounted in the train; *center*, operating engineer's compartment; *bottom*, oil filter and some of the accessory units mounted at the end of one of the auxiliary engines.

A. K. Brumbaugh, Pacific Coast representative, Timken-Detroit Axle Co., and C. B. Lindsey, superintendent of automotive equipment, Los Angeles Railway Co., were other speakers at the meeting. John M. O'Malley was chairman.





S A E

National Tractor Meeting

Milwaukee **April 14 & 15**

Schroeder Hotel

Under Auspices of Tractor & Industrial Power Equipment Activity

PROGRAM

Thursday, April 14

10:00 A.M. **Transmissions and Axles**

B. W. KEESE, *Chairman*

Deflection Tests on Transmissions and Axles – E. G. BODEN, *Timken Roller Bearing Co.*

2:00 P.M. **Plant Visit**

International Harvester Co., Milwaukee Works.

6:30 P.M. **"Tractor Styling" Dinner**

C. E. FRUDDEN, *Chairman*
V. R. JACOBS, *Toastmaster*

Styling of Automobiles, Trucks and Tractors – RAY DIETRICH, *Chrysler Corp.*

Friday, April 15

9:30 A.M. **Plant Visit**

C. E. FRUDDEN, *Chairman*

The new West Allis Tractor Works, Allis-Chalmers Mfg. Co.

2:00 P.M. **Engine Wear Symposium**

J. S. ERSKINE, *Chairman*

1. Valves – A. T. COLWELL, *Thompson Products, Inc.*
2. Ignition – E. S. TWINING, *Champion Spark Plug Co.*
3. Rings and Cylinders – M. O. TEETOR, *Perfect Circle Co.*
4. Shop Practices – K. W. CONNER, *Micromatic Hone Corp.*
5. Lubrication – C. M. LARSON, *Sinclair Refining Co.*
6. Hardening of Crankshafts and Cylinder Barrels – *Representative of International Harvester Co.*

succeed in the use of sealing rings in automotive-type engines. So far, however, all have failed because of being unable to control oil pumping. When sealing rings are used, this condition is magnified approximately 20 per cent."

In discussion Pat Schlessinger, superintendent of the Ponca City Light Plant, spoke particularly with reference to the effect of gas pressure behind the rings causing excessive wear and told how the misalignment of pistons on a large Diesel engine, through improper shimming of cross-head guides, resulted in excessive ring wear that was centered principally on one-half of the ring. He pointed out that the cause of the ring wear probably could be traced to the unbalanced gas volume behind the rings on opposite sides of the piston, the excessive wear occurring on the side of the piston having greatest clearance between piston skirt and cylinder wall.

B. E. Sibley, Continental Oil Co., spoke of the effect of capillary action, stating that in all probability a lubricant, when fed in through the compressor suction line, assists the upper rings in sealing the piston and cylinder by means of a liquid seal.

Other discussers included R. D. Best, Continental Oil Co., and O. Adams.

Although a severe sleet storm was raging the Feb. 18 meeting of the SAE Tulsa Group attracted 74 persons, including specially invited guests from sections of the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the American Institute of Mining and Metallurgical Engineers, the Oklahoma Transportation Association, the Petroleum Motor Transportation Association and students from the University of Tulsa.

A. D. Martin, field engineer, Ethyl Gasoline Corp., Los Angeles, was the speaker at the meeting which was held at the Ethyl Clinic. He discussed trends in passenger-car design, the part gasoline plays in the development of high-output engines and motor tune-up in relation to engine efficiency. Mr. Martin used a chassis dynamometer to illustrate some of his points.

Tin-Coated Piston-Rings Said to Reduce Scuffing

● Canadian

"The piston-ring has presented more problems to the motor builder, foundryman and engineer than many larger and more important parts," B. A. Yates, chief metallurgist of McQuay-Norris Manufacturing Co., told some 126 members and guests of the Canadian Section in reading his paper, "Recent Developments in Piston-Ring Materials," at its Feb. 16 meeting. He recalled that as far back as thirty years ago there were manufacturers specializing on piston-rings and stated that from then until now the job has continued to be in the hands of specialists.

Mr. Yates spoke particularly on the application of a thin, soft layer of tin to piston-rings as a means of diminishing ring scuffing.

In analyzing the causes of piston-ring wear he listed them as abrasion, corrosion and erosion; the same factors which affect the wear life of cylinders.

Of these he named abrasion as the greatest single factor of cylinder and ring wear and as the most easy to eliminate. It has been reduced by motor builders through use of proper cleaning equipment during the various stages of manufacture and by providing proper oil filters, crankcase-ventilator screens and suitable air filters, he said. The speaker declared that attempts to reduce abrasive wear by changing the composition and structure, and increasing the hardness of cylinder and piston-rings have shown but slight improvement, and quite generally have proven very disconcerting to the designing engineer.

Corrosion, he feels, is probably the most elusive wear factor and therefore the most difficult to provide protection against. Thorough and quick warming-up and proper crankcase ventilation, he said, seem to afford the chief solution to this problem. Further improvement might result from the use of cylinder-bore and piston-ring material more corrosion resistant than used at present, he added.

Erosion, or the tearing-out of metal from one or both of the surfaces which are moving relative to each other occurs when there is metal-to-metal contact due to failure of the lubricating oil film, he explained. Mr. Yates explained that this is due to the fact that the additional friction and heat caused by the metal-to-metal contact produces an external force which exceeds the cohesive or adhesive force tending to retain the metal at the surface. Continuing he said: "if this erosive effect takes place at a slow rate, the small particles of loose metal roll and slide over each other, developing smooth surfaces. A slightly greater rate of metal removal results in scuffing, and a more rapid rate generally causes scoring."

Assuming that no great improvement of the condition can be secured by providing more adequate lubrication, Mr. Yates stated that the only other possible solution would be to improve the metal characteristics of the cylinder wall and piston-rings so as to offer greater protection against erosive conditions.

Using numerous slides Mr. Yates reported on tests made by his company which, he believes "allow us to state correctly, first, that protective coatings on pistons will not prevent rings and pistons from scuffing or scoring; second, that rings made by various manufacturers with plain or untreated surfaces will not prevent this condition; third, that tin-plated coatings on rings offer greater protection than non-metallic coatings, and, fourth, that regardless of piston surface, assuming the mechanical set-up to be the same in every case, a protective

film of soft tin will add greatly to the ability of rings to resist scuffing and thereby protect the piston from erosive conditions such as scuffing and scoring."

He noted also that tests showed that the relatively soft film of tin aids in eliminating blowby during the early run-in period and greatly adds to the over-all wear life. Actual tests for 10,000 miles of operation, he said, have shown that tin-plated rings will show only one-third as much wear as the plain untreated type.

Students Hear Talk On Sales Promotion

● **U. of Detroit**

Student Branch members at the University of Detroit learned how the sales promotion department of a large automobile company operates when J. W. Vance, merchandising manager, DeSoto division of Chrysler Corp., addressed them at their March 2 meeting. Another speaker, Lieut. Sam Triffy, an alumnus of the University, gave a résumé of his student days at Army air schools in Texas.

Mr. Vance credits the desire of everybody in the United States to own a car as the basic reason for the magnitude of the automotive industry. He noted, however, that in the past few years the used car has become a problem to the manufacturers and limits the amount of new cars that can be sold. At the present time, he said, the ratio of used car sales to new is approximately 1.6 to 1.

He told how the state governments, by requiring that each owner register his car, aid automobile sales departments in a way that they do not aid any other sales departments. These registration lists are analyzed for prospects and give information as to the type of car a prospect would be most interested in, he explained.

Lieutenant Triffy observed that the life of a flying cadet at Army air schools is not an easy one, but that it is intensely interesting and one that will not be forgotten during a lifetime.

Load Capacity of Rubber Said Similar to Fluids

● **Cleveland**

Vulcanized rubber is practically incompressible and therefore, when properly confined, can be safely loaded to terrific pressures, just like any fluid, Fred L. Haushalter, development engineer, B. F. Goodrich Co., told more than 100 engineers at the March 14 meeting of the Cleveland Section, in his paper, "Rubber as a Load-Carrying Material."

SAE President C. W. Spicer and General Manager John A. C. Warner, were guests of honor at the meeting. Introduced by Mr. Warner, Mr. Spicer spoke briefly, pointing out the varied phases of transportation included in the organized activities of the SAE, and indicating opportunities for expansion in each of these fields. He also spoke of opportunities for closer cooperation between engineers of the two great transportation industries – automotive and railroad.

Mr. Haushalter stated that by far the most important consideration in the use of rubber as a load-carrying material is that of permanent set or creep. Most limitations of stress and elongation in rubber, he explained, hinge about this single factor.

According to the speaker the art of bonding rubber to metals has been very well accomplished, but much attention is still being given to that property which metallurgists would call slip, and which is analogous to interfacial slippage between crystals of a metal. The slippage is remarkably little, he said, when one considers that, as a raw material, rubber is one of the very few materials which can be stretched 700 per cent at ordinary temperatures before breaking. Some vulcanized rubbers, he added, can be stretched even more than 1000 per cent.

The carbon atoms of the rubber molecule, Mr. Haushalter explained, lie in zig-zag linkages of various lengths. On stretching the linkages straighten out, perhaps with free rotation, at points of single bonds. Vulcanization greatly reduces the slippage, or creep, in the molecule structure, he pointed out. The evidence seems to indicate that bridges of sulphur tenaciously join together the molecular structure with an attending stiffening action, he continued.

The speaker also stated that there is a tight packing of rubber molecules as stretching occurs, as there is a slight increase in density and also a slight increase in surface hardness.

Working stresses in rubber under tension, torsion or shear should be limited to 40 to 70 lb. per sq. in. of cross section, depending upon conditions and the hardness of rubber used, he stated, adding that the strain should be limited to 100 per cent. From available curves for certain types of rubber, he said, it is possible to predict how much creep will occur in a rubber spring of a definite compound at the end of a definite time, when loaded under specified conditions.

He explained further that pre-loading of such springs before using will remove much of the initial creep. However, he stated, accelerated creep tests indicate that two springs, one pre-loaded and then released and the other not pre-loaded, will eventually reach the same level under the same conditions of service.

In summing up, Mr. Haushalter stated that the limitations of the use of rubber are determined by long-time creep or slip, which in turn is directly related to the magnitude of stress and distortion in the material. He noted that vulcanized rubber is practically incompressible and that, when properly confined, can safely be loaded to terrific pressures. To know how it

Section Regional
Public Utility Fleet Meeting

Cleveland **April 28 & 29**

Hotel Statler

Sponsored by the SAE Cleveland Section and the Transportation and Maintenance Activity

PROGRAM

Thursday, April 28

10:00 A.M. **Bodies**

L. L. WILLIAMS, *Chairman*

Present and Future Trends in Public Utility Truck Bodies and Equipment – P. E. HAWKINS, *Baker-Raulang Co.*, and N. P. LARSON, *American Coach & Body Co.*

2:00 P.M. **Plant Visits**

F. B. JONES, *Chairman*

American Coach & Body Co.
Baker-Raulang Co.
White Motor Co.

6:30 P.M. **Cleveland Section Social Half Hour**

7:00 P.M. **"Utilities" Dinner**

ARTHUR TOWNHILL, *Chairman*

J. N. BAUMAN, *Toastmaster*

Some Interesting Facts about T.V.A. – F. A. NEWTON, *Commonwealth & Southern Corp.*

No reserved places at the Dinner

Tickets $2.00 each
May be obtained from: Hoy Stevens, 600 Midland Bldg., Cleveland.

Friday, April 29

10:00 A.M. **Chassis**

H. E. SIMI, *Chairman*

Application of Truck Chassis to Public Utility Use – J. R. NORTH, *Commonwealth & Southern Corp.*

2:00 P.M. **Symposium**

K. D. SMITH *and* T. S. KEMBLE, *Chairmen*

1. Why Continue the Use of High Pressure Truck Tires? – J. E. HALE, *Firestone Tire & Rubber Co.*
2. Engine Deposits – Cause and Effect – FRED HEINLEIN, *Cincinnati Gas & Electric Co.*
3. The Importance of Periodic Motor Tune-Up – E. J. GAY, *Ethyl Gasoline Corp.*

8:00 P.M. **Public Utility Fleet Supervisors' Conference**

R. H. CLARK, *Chairman*

will behave and stand up under various conditions of application, he explained, is not only a matter of knowing how to compute the actual stresses set up in the material, but of knowing something about the fatigue resistance of the various compounds of rubber which might be used.

GM Diesel Described

The development and characteristics of the new General Motors two-cycle Diesel engine were outlined before one of the largest Cleveland Section meetings in years when John Dickson, assistant chief engineer, Diesel Engine Division of General Motors, spoke at the Feb. 14 meeting.

Early in the development of this engine, the speaker said, a group of research engineers were given the job of building a single-cylinder Diesel engine, which could be built in multicylinder units. These men were free from commercial pressure and had no time limit or production schedules to meet. Without this pressure they were free to choose the harder task – that of the two-cycle engine, because of the many advantages which would result if they were successful in the development of such an engine, Mr. Dickson stated.

The uniflow-system of scavenging was finally adopted, with the incoming air entering the cylinder through a port at the bottom, and the exhaust gases leaving the cylinder by means of an exhaust valve in the head, he said. In some of the engines, according to the speaker, it was necessary to exhaust the gases and replenish the cylinder with fresh air in one one-hundredth of a second. Also, he added, lubrication of the cylinder walls and control of oil consumption, usually a problem in two-cycle construction, appeared to be best accomplished by the uniflow system.

Mr. Dickson spoke of another unusual feature, a unit fuel injector, which was developed to spray the fuel into the cylinder. This injector, operating at the extreme pressure of 20,000 lb. per sq. in., is located close to the discharge orifice, and eliminates all high-pressure piping, he explained. The effect of these high pressures resulted in very fine atomization of the fuel spray and gives a rapid pressure rise in the cylinder without undue knock, he reported. The speaker stressed the importance of clear exhaust characteristics, with high two-cycle brake-mean-effective-pressure values. The injector itself, he said, is supplied from a booster pump at 20 lb. per sq. in. pressure; fine-edged strainers located in the injector itself strain the fuel.

In commenting upon the many troubles encountered in piston development, Mr. Dickson listed seizure, ring-gumming, crown cracks, and high oil consumption as being the worst. These were eliminated, however, he explained, and a number of multicylinder engines constructed at the Cleveland plant. At the present time, over 167,400 hp. are in service and on order for railroad service in this country, he reported, stating that some of these engines complete over 300,000 miles without a major overhaul.

In discussion, H. E. Simi said that the application of Diesel engines to the bus and truck field has progressed very rapidly during the past three years. One fleet of vehicles with which he was familiar had fuel consumption figures of 3.13 miles per gal. for a gasoline-mechanical drive, 2.5 miles per gal. for a gasoline-electric drive, and 4.73 miles per gal. for a Diesel-electric drive. Savings in fuel costs are quite apparent on this basis, he said. Assuming a normal yearly service of 40,000 miles, a gasoline cost of 15½ cents per gal. and a fuel oil cost of 10¾ cents per gal., we find that the annual fuel cost for the gasoline-mechanical drive is $1,980; for the gasoline-electric drive is $2,480, and for the Diesel-electric drive is $910, he concluded.

President Spicer Visits Eastern SAE Sections

SAE President C. W. Spicer and the Society's general manager, John A. C. Warner, visited the Metropolitan, Philadelphia, Cleveland, Pittsburgh, Southern New England and New England Sections last month, and also attended the Society's National Aeronautical Meeting in Washington, D. C.

During the Spring, Messrs. Spicer and Warner plan to visit other eastern Sections and this Fall they expect to make a tour of the western Sections.

On April 12 they will be guests of honor at a special Indiana Section meeting to be held on the campus of Purdue University. The Student Branch at Purdue will be host.

More Than 300 Attend Two-Session Fuels and Lubricants Meeting

● **Kansas City**

WHAT happens to liquids and solids when subjected to a pressure of 1,500,000 lb. per sq. in., evaluation of hypoid lubricants, lubricants of tomorrow and engine deposits were the vital subjects under discussion at the two-session meeting of the Kansas City Section, March 4.

More than 225 members and guests were on hand for the afternoon session which was chairmanned by Ralph R. Matthews, Battenfeld Grease and Oil Corp., and attendance reached more than 300 when the evening session was called to order by Dr. Earl D. Hay, assistant dean of engineering, University of Kansas. Section Chairman E. W. Pughe presided at the dinner.

Any gear lubricant must have the ability to prevent serious wear or distortion of the contact surfaces under all reasonable kinds of service during the life of the lubricant, Dr. C. F. Prutton, professor of chemical engineering, Case School of Applied Science, declared in presenting the opening paper of the meeting, which he prepared jointly with A. O. Willey, assistant professor of mechanical engineering at the same school.

A hypoid lubricant, in order to meet these requirements, he said, must: (1) possess a sufficiently high load-carrying capacity, or film strength, which must remain fairly constant during the life of the lubricant, to maintain a negligible amount of wear on the gear teeth under all types of service load application; (2) be practically free of abrasive solids; (3) be fairly stable under service conditions. He added that a hypoid lubricant is required to possess suitable other properties such as viscosity, pour point, foaming and channeling characteristics.

In discussion of the paper B. E. Sibley, Continental Oil Co., predicted that improved hypoid lubricants will be seen in the future. Smaller pinion gears and greater loads requiring better lubricants were forecast by O. L. Magg, Timken Roller Bearing Co.

Answering a question as to whether the use of different materials in hypoid gears would make any difference, Mr. Magg said that at present various alloy steels are used and that the alloy composition of steel does not seem to make much difference. He added that the hardness, however, is important.

Professor Price, University of Kansas, asked about the lapping and coating effect of oils on gears and how they prevented seizure. In reply, Dr. Prutton stated that some component of the lubricant adheres tightly on the surface of the metal and thus prevents the lubricant being squeezed out. Also, he said, some component in the lubricant at points of high pressure causes a very minute amount of chemical reaction, either with some other component of the lubricant or with some solid, which prevents seizure. At temperatures around 400 deg. fahr., he continued, chemicals attack metal surfaces and form a solid which prevents seizure.

Arch L. Foster, technical editor, *National Petroleum News*, spoke on "Characteristics of Tomorrow's Lubricants; Sources and Technology of Super Lubricants," as the second speaker.

During the course of his paper, Mr. Foster stated that it is safe to say that the ultra-modern crankcase oil will contain at least six components, each selected because of its specially high qualities under one of the four major properties which are: (1) viscosity; (2) oxidation stability; (3) film strength, and (4) pour point. He believes that the main part of the lubricant will be composed, as now, of a mineral base, but not the rather all-inclusive catch-basin product now used. The lubricating fraction of petroleum, he said, will be dissected, taken apart, separated into classes of hydrocarbons, eliminating the easily oxidizable portions, the low viscosity-index and the poor film-strength materials. Those portions having the highest film strength, highest viscosity index, greatest oxidation resistance and the best pour characteristics which can be obtained along with the other more important properties will be re-combined to form the base or carrier for the other more highly specialized products, in cost cases synthetic, each of which is added to raise a given property to the highest practical value.

In discussion of Mr. Foster's paper Mr. Sibley remarked that straight mineral oil can no longer take care of the maximum duty which confronts it in an airplane engine, and that it must be reinforced by other components.

Opening the evening session Dr. Thomas C. Poulter, director of the research foundation at Armour Institute of Technology, presented his paper, "The Effect of Pressures up to 1,500,000 Pounds."

Dr. Poulter stated that a pressure of 1,500,000 lb. per sq. in. is equal to pressure at a depth of 200 miles. He also said that the volume of liquids and solids may be reduced more than 50 per cent under pressure and that the viscosity of liquids and some petroleum oils is affected more than two million fold. Many materials which are liquid at atmospheric pressure, he said, may become solid, with a hardness comparable to metallic lead or copper, under extreme pressure. He added that present-day instantaneous pressures in hypoid gears are sufficient to produce this effect upon some materials.

In discussion, answering a question asked by H. W. Morrow, Sinclair Refining Co., Dr. Poulter stated that very little work has been done with gas. However, he said, pressures have been applied up to 12,000 atmospheres. He also remarked that hydrogen has been compressed so that the density was twice that of normal liquid gas.

Answering another question from the floor, Dr. Poulter stated that most light oils stay liquid under pressure, although some get as hard as metallic copper. He remarked that in one test a piece of 20-gage copper wire was placed in the oil and that while under pressure the oil, slipping on itself, cut the copper wire into pieces no larger than a millimeter in thickness.

E. F. Lowe, assistant general manager of the SAE, was introduced by Dr. Hay, and, after

(*Continued on page 32*)

New Members Qualified

These applicants who have qualified for admission to the Society have been welcomed into membership between Feb. 15, 1938, and March 15, 1938.

The various grades of membership are indicated by: (M) Member; (A) Associate Member; (J) Junior; (Aff.) Affiliate Member; (SM) Service Member; (FM) Foreign Member.

Buffalo Section

MAURER, HERBERT N. (J) product engineer, J. H. Williams & Co., 400 Vulcan St., Buffalo, N. Y. (mail) 722 Northampton St.

Canadian Section

CHANDLER, WALTER GEO. DAVID (A) representative, McQuay-Norris Mfg. Co. of Canada, Ltd., Toronto, Ontario, Canada. (mail) 6 Hounslow Heath.

HANSON, PAUL R., LIEUT. COL. (A) division manager, Dunlop Tire & Rubber Goods Co., Ltd., 1619 William St., Montreal, Quebec, Canada.

TAYLOR, WILLIAM W. (A) assistant general manager, Prest-O-Lite Storage Battery Co., Ltd., 1360 Dufferin St., Toronto, Ontario, Canada.

Chicago Section

PECK, D. CAMERON (J) assistant to president, Bowman Dairy Co., 140 W. Ontario St., Chicago, Ill.

READ, CYRIL M. (M) engineer, Stewart Warner Corp., 1828 Diversey Ave., Chicago, Ill.

TAYLOR, HARRY NEWTON (J) assistant research engineer, Standard Oil Co. (Indiana), Engine Laboratory, Whiting, Ind.

Cleveland Section

MILLER, HERMAN RUSSELL (J) development engineer, Firestone Tire & Rubber Co., Akron, O. (mail) 68 E. Archwood Ave.

Dayton Section

COLUMBUS METAL PRODUCTS, INC. (Aff.) 767 N. Fourth St., Columbus, O. Reps.: Donley, H. B., vice-president and general manager; Yerges, Howard, engineer.

HEWITT, CHARLES H. (M) president, Dayton Forging & Heat Treating Co., 2323 E. First St., Dayton, O.

Detroit Section

EATON, JOSEPH O., JR. (J) engine research, Eaton Mfg. Co., 9771 French Road, Detroit, Mich.

FAY, BYRON A. (M) vice-president, Electric Auto-Lite Co., Toledo, O. (mail) 2811 Inwood Drive.

HUNT, GEORGE ELLIOTT, JR. (J) test engineer, General Motors Proving Ground, Milford, Mich.

KELLY, MOORE, JR. (A) salesman, Bound Brook Oil-less Bearing Co., 1255 Book Bldg., Detroit, Mich.

MCINTYRE, B. D. (A) president, Monroe Auto Equipment Co., Monroe, Mich.

STEPHENS, R. L. (SM) engineering flight inspector, U. S. Bureau of Air Commerce, Washington, D. C. (mail) Post Office Box 779, Detroit, Mich.

Indiana Section

SCHWITZER, LOUIS HENRY, JR. (J) vice-president, Schwitzer-Cummins Co., 1125 Massachusetts Ave., Indianapolis, Ind.

Kansas City Section

OLDHAM, R. J. (J) student engineer, Chevrolet-Kansas City Division of General Motors Corp., 6801 E. 37th St., Kansas City, Mo. (mail) 7115 Sni-A-Bar Road, Eastwood Hills.

Metropolitan Section

CARTER, LEON T. (M) engineer, General Electric Co., 570 Lexington Ave., New York City. (mail) 122 Crestwood Ave., Crestwood, N. Y.

CLOUD, GOULD H. (M) Standard Oil Development Co., Esso Laboratories, Elizabeth, N. J. (mail) 18 Sayre St.

GARDOTZKI, THEODORE J. (J) plant and experimental engineer, Kaster Specialty Mfg. Co., Inc., 510-518 Sixth Ave., New York City. (mail) 24-32 31st St., Astoria, L. I., N. Y.

OLIVER, HORACE GISMOND, JR. (J) engineer, M. W. Kellogg Co., 225 Broadway, New York City.

New England Section

BRYANT, RICHARD U. (J) Massachusetts Institute of Technology, Development Dept., Cambridge, Mass. (mail) 47 Carver Road, Watertown, Mass.

Northwest Section

PRICHARD, EVAN (M) engineer, Tricoach Corp., 703 Sixth Ave., N. Seattle, Wash.

Philadelphia Section

ANTHEIL, ROBERT E. (M) engineer, Thermoid Co., Trenton, N. J.

Southern California Section

LONG, P. C. (A) inspector, Vultee Division of Aviation Mfg. Corp., Downey, Calif. (mail) 821 N. Elmwood Ave., Burbank, Calif.

WEISE, CARL A. (J) engineer, Atlas Imperial Diesel Engine Co., Mattoon, Ill. (mail) 2358 Lemon Ave., Long Beach, Calif.

Southern New England Section

DAY, ALFRED VINCENT (J) engine tester, Pratt & Whitney Aircraft, East Hartford, Conn. (mail) 111 Whiting Road.

FISK RUBBER CORP. (Aff.) 154 Grove St., Chicopee Falls, Mass. Rep.: Benson, A. E., tire construction engineer.

OWEN, A. CHANT (A) equipment sales, G. & O. Mfg. Co., New Haven, Conn. (mail) 138 Winchester Ave.

Outside of Section Territory

LAMPTON, G. T. (M) project engineer, Aviation Mfg. Corp., Lycoming Division, Williamsport, Pa.

Applications Received

The applications for membership received between Feb. 15, 1938, and Mar. 15, 1938, are listed herewith. The members of the Society are urged to send any pertinent information with regard to those listed which the Council should have for consideration prior to their election. It is requested that such communications from members be sent promptly.

Chicago Section

BROWN, EDWIN C., assistant chief engineer, Western Austin Co., Aurora, Ill.

HENDRICKS, GERALD E., president, Hendricks Research Corp., Chicago, Ill.

POPE, GEORGE H., superintendent of garages, Chicago Daily News, Inc., Chicago, Ill.

ROURKE, BRANDON E., editor, Shaw Publishing Co., Chicago, Ill.

SMIRL, RICHARD L., engineer, Borg & Beck, Division Borg Warner Corp., Chicago, Ill.

SUNDFOR, ALFRED HAROLD, research laboratory assistant, International Harvester Co., Chicago, Ill.

WILLIAMS, SIDNEY J., director, Public Safety Division, National Safety Council, Chicago, Ill.

Cleveland Section

BUCKWALTER, NORMAN ROBERT, aid to chief engineer, Hercules Motors Corp., Canton, O.

CLARK, ARTHUR, quality engineer, Hercules Motors Corp., Canton, O.

HEATH, GEORGE A., The Colson Corp. of Elyria, Elyria, O.

READ, GEORGE E., manager, Cleveland Calumet Refining Co., Cleveland, O.

SUNDORPH, EILER C., president and general manager, Sundorph Aeronautical Corp., Cleveland, O.

Detroit Section

DEMONET, JULES ALOYSIUS, engineer, Chrysler Corp., Highland Park, Mich.

HUNT, CHARLES KELLOGG, research chemist, Sharples Solvents Corp., Wyandotte, Mich.

KNOBLOCK, FREDERICK DELBRIDGE, Bundy Tubing Co., Detroit, Mich.

Indiana Section

PEARSON, JOHN EDWIN, engineer, auto heater, Noblitt-Sparks Industries, Inc., Columbus, Ind.

Kansas City Section

BRITTON, S. CORWIN, chemist in charge of Kansas City Section, Phillips Petroleum Co., Kansas City, Kan.

JOHNSON, PAUL F., safety engineer, Ethyl Gasoline Corp., N. Kansas City, Mo.

THOMAS, GEORGE H., field representative, Ethyl Gasoline Corp., N. Kansas City, Mo.

Metropolitan Section

MAHONY, JEROME, service and sales, John B. Mezey, New York City.

SCHICK, EDWARD MARTIN, 1267 Pacific St., Brooklyn, N. Y.

SMITH, ARTHUR E., JR., salesman, Smith & Gregory, New York City.

STESEN, STEEN, chief clerk, The Texas Co., New York City.

WOHLERS, HENRY, auto mechanic, Ruth & Mathews, Brooklyn, N. Y.

WOODBURN, MELVERN C., 83-14 St. James St., Elmhurst, N. Y.

Milwaukee Section

SARTWELL, CLINTON EDGAR, chief engineer, Oshkosh Motor Truck, Inc., Oshkosh, Wis.

Northern California Section

HEAKIN, HAROLD L., Pacific Foundry Co., San Francisco, Calif.

MERRILL, HOMER DWIGHT, junior mechanical engineer, Tidewater Associated Oil Co., Associated, Calif.

Philadelphia Section

HODER, FRANK JOSEPH, JR., charge of experimental laboratory, National Supply Co., Philadelphia, Pa.

HUFNAGEL, F. B., JR., manager, motor transportation, Sun Oil Co., Philadelphia, Pa.

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SAE National Aeronautic Meeting

(*Continued from page 15*)

Aircraft Session

T. P. Wright, *Chairman*

GROUND training methods that give pilots a chance to have a "dress rehearsal" before actual flight; the story of the development of the "three-spot system" of single-instrument blind landing at the Bureau of Air Commerce; and a mathematical demonstration of the influence of shear deformation on bending stresses in box beams, made up the varied fare of this session. The three papers appeared on the program respectively as: "Bending Stresses in Box Beams as Influenced by Shear Deformation," by Paul Kuhn, National Advisory Committee for Aeronautics; "Recent Air Commerce Development in Instrument Landing," by I. R. Metcalf, Bureau of Air Commerce; and "Ground Training for Instrument Flying," by Capt. Carl J. Crane, U. S. Army Air Corps.

Happy Correlation Indicated

An analysis of the errors in the calculated stresses due to bending, owing to the presence of shear deformation of the web, using the ordinary theory, was presented by Mr. Kuhn in the first paper. Applying this analysis to several cases of typical box beams built up of thin metal sheet and stringers, he showed the relative efficiency of various typical arrangements and emphasized that the use of the simple beam formula is unconservative. He brought out that, in many cases where excessive stresses arose, consideration of the beam as a statically indeterminate structure led to the conclusion that thickening of the skin was the proper procedure.

In opening the discussion Mr. Wright pointed out that Mr. Kuhn's conclusion indicated a happy correlation between structural and aerodynamic requirements. Recent researches had emphasized the desirability of smooth, unrippled skins for aerodynamic reasons and this type of skin now appeared consistent with structural considerations. In further discussion the question of double flexure (for example, by chord and beam-wise bending) was raised. In reply Mr. Kuhn stated that the stresses did generally build up to the calculated values in the most highly stressed corner, and that little relief could be expected from stress redistribution under these circumstances.

Blind-Landing with One Instrument

In the second paper Mr. Metcalf spoke of recent Bureau of Air Commerce development in instrument landing. He stated that the subject of blind landing enjoyed a great deal of attention although the accident records as yet had revealed no accident resulting directly from blind-landing circumstances. He described the basic development of a "three-spot system" in which three lights properly located with respect to a runway were used to give the pilot information as to both position and orientation of the airplane. From this work, he pointed out, it was concluded that a single instrument embodying the three-spot system could be used for blind-landing purposes. Working along this line the Bureau, with the cooperation of the Massachusetts Institute of Technology, is developing a combined radio- and gyroscopic-operated system to control three cathode-ray spots projected on a screen, Mr. Metcalf said. The method is thus far in the early stages, and the weight of equipment is considerable, he reported. Another interesting conclusion reached was that the combined use of visual and aural indications was not satisfactory, Mr. Metcalf concluded.

Pilot Training Demonstrated

Captain Crane, the next speaker, described first the early studies of Ocker and Meyers to determine the source of pilot difficulties in utilizing instrument indications. He then gave an extensive description of recent Air Corps developments in the use of the Link Trainer including simulation of a wide variety of flight situations and problems. All this procedure, he said, really gave pilots a chance to have a dress rehearsal of the drama that they must later enact in flight.

In conclusion he demonstrated the inability of a normal person to sense rate of turn without visual reference, and brought out how the use of a turn indicator gave correct indications often disagreeing with the subject's sensory perception. Just before the session adjourned Captain Crane demonstrated the operation of a standard Air Corps instrument panel.

Propellers Session

R. N. DuBois, *Chairman*

HUGE fantastic devices 40 ft. or more in diameter and with three to six blades, looking more like Dutch windmills than conventional aircraft propellers, may propel future airplanes according to several prognostications made at the propeller symposium.

After opening the session, Chairman DuBois turned over the meeting to F. W. Caldwell, Hamilton Standard Propeller Co., who directed the symposium on the subject of "Propeller Limitations on the Size of Aircraft Engines," which was made up of three papers: "Propeller Problems Imposed by Substratosphere Flight Requirements," by C. F. Baker, Hamilton Standard Propeller Co.; "Propeller Factors Tending To Limit Aircraft Engine Powers," by G. T. Lampton, Lycoming Division, Aviation Mfg. Corp.; and "Aerodynamic Considerations Affecting Propellers for Large Aircraft Engines," by George Brady, Curtiss Aeroplane Co.

Heavier Propellers for Substratosphere

"Even closer coordination of airplane, engine, and propeller designers than exists today will be required to solve the problems of high-power substratosphere flight and to insure the most efficient conversion of power," predicted Mr. Baker, the first speaker of the symposium. This type of flight, he continued, will require propellers that are appreciably heavier than present ones and, as a result, every effort should be made to reduce propeller weights.

Of the methods of weight reduction discussed, Mr. Baker believes that the most practical is through the use of lighter materials or different types of construction for the blades. The possibilities of employing lighter materials, such as magnesium, he pointed out, depend upon the ability of metallurgists to produce a uniform product having acceptable properties. Hollow-steel propellers, thinks Mr. Baker, might be lighter but they would complicate the situation from the

vibration standpoint. Plastics also must be given consideration for propellers, he continued, as recent developments indicate that satisfactory properties may be available in the near future. These methods may reduce the specific weight in the order of 15 or 20 per cent, he estimated.

Although it will be necessary to employ large-diameter propellers of few blades for large planes in the substratosphere to deliver the required performance, small airplanes can employ multiblade propellers where the take-off performance is not critical, he pointed out. The problem of torque will be appreciable for these small planes, he added, suggesting counter-rotating propellers as a possible solution. Mr. Baker concluded by displaying results of tests comparing three-blade, four-blade, and counter-rotating propellers.

Courage Held Only Limitation

"There appears to be no limit to the size of future aircraft powerplants other than the courage of the industry," believes Mr. Lampton. In the last analysis, he explained, the airplane designer will have to select powerplants of a size which will give him the number of independent units dictated by safety considerations, and must weigh possible weight penalties against aerodynamic improvement, maintenance requirements, and so on. Increasing velocities will permit larger engines and, therefore, larger gross weights, which establishes a cycle with further increase of speed.

At present our transports and bombers are operating in the vicinity of 200 to 300 ~~m.p.h.~~, Mr. Lampton reported, and the propeller problems are not too difficult. With increased powers and stratosphere operation, he continued, there will be a rapid advance on the 400 m.p.h. zone, which must be accompanied by increased pitches and, eventually, by a loss in efficiency.

"If present trends – increasing engine powers, gross weights, airplane performances, and displacements – persist, propellers previously considered in the Zeppelin size category will shortly be standard equipment on pursuit ships," Mr. Lampton predicted.

The real propeller limitation on engine sizes, if any, resides in the increasing weight of the propeller and, therefore, tip speeds will be maintained high and constant with increasing power, he concluded, basing his statement on the assumption that propeller weights will be proportional to the cube of their diameters.

I am very much concerned that future airplane propellers may look like Dutch windmills, he concluded.

Propeller Compared with Autogyro Rotor

"Propellers for engines of several times present powers will operate just as efficiently as those for smaller powers," was the conclusion of Mr. Brady who gave his views from the aerodynamic standpoint. The autogyro rotor is very similar to the aircraft propeller in general form, and successful rotors have been built having three or four blades 30 or 40 ft. in diameter and weighing less than 500 lb., he pointed out. Conceding that propeller torques and thrusts are higher than those of rotors of the same diameter, Mr. Brady contended that the weight of a 30-ft. three-blade propeller suitable for carrying 5000 hp. could be two or three times that of the rotor without being out of line with present specific weights.

Referring to the possible limitation of propeller weight Mr. Brady stated: "If weight is the only factor that stands in the way of the higher-powered units, methods will be found to overcome the difficulty . . . even with conventional construction and materials, substantial size increases can be made without running into excessive weight."

Another design consideration that might hold down engine size discussed by Mr. Brady is clearance of the propeller tips either with the ground, fuselage, or adjoining propellers. Said he: "Without predicting the form that aircraft will assume with increasing size, it is impossible to say positively that propeller diameter will not be a limiting factor to powerplant size but, since airplane dimensions increase in proportion to propeller diameter, such difficulty seems unlikely."

For long-range aircraft operating at altitudes of 20,000 to 30,000 ft., three-blade propellers increased somewhat in diameter over those of current practice are indicated definitely, Mr. Brady concluded after discussing the results of a study on three- and four-blade propellers.

"It is indeed encouraging to hear from the propeller engineers themselves that they do not fear that propeller weights will limit the size of future aircraft engines," remarked T. P. Wright, Curtiss-Wright Corp., in written discussion. The point that Mr. Lampton raises concerning a decrease in propeller efficiency at speeds over 300 m.p.h. is interesting as representing a possible limitation in the ultimate speeds that aircraft may hope to attain, he concluded.

Although the data presented are very useful, there are more factors involved than can be put together in a simple manner, and we must be careful in drawing general conclusions, cautioned Fred E. Weick, Engineering & Research Corp.

There are so many variables involved that the authors were forced to develop typical cases and neglect some variables, pointed out T. B. Rhines, United Aircraft Corp. For example, he continued, all three papers ignored the effect on propeller performance of varying the blade width instead of the number of blades.

Developments not considered likely at the present time might change the whole picture, suggested Dr. J. C. Hunsaker, Massachusetts Institute of Technology. Suppose assisted take-offs became general, he pointed out, then propellers had better be small with lots of blades. The field of plastics presents another threat of a change, he went on, as these materials are now being produced that are insensitive to scratches and have no fatigue troubles.

Not enough consideration has been given to what the big engines will be like that will drive these propellers, contended Harold Caminez. They will be dynamically balanced both in the primary and secondary, and drives will be made "softer," he predicted.

Some work has been done on steam powerplants for aircraft in Germany that shows that they become economical at about 5000 hp., reported J. H. Geisse, Bureau of Air Commerce. Such engines would be free from the vibration characteristics of internal-combustion engines and their effect on propeller design, he pointed out.

Answering Mr. Geisse's question as to whether transmissions driving two or more propellers from one engine would be feasible, Mr. Lampton replied that he believes the reverse condition – two powerplants driving one propeller – would be more practical for reasons of safety and maintenance.

Summarizing the session, Mr. Caldwell opined that the papers point out certain trends, stimulate a critical point of view of the work now in progress, and act as a challenge for future research.

Small Planes Session

J. H. Geisse, *Chairman*

A FRANK appraisal of the status of private flying in this country by an enthusiastic private flyer and a survey of the engines that power these light planes were presented in the two papers delivered at this session. Interest in the development and problems of this promising branch of aviation was evidenced by the wide and vigorous discussion that fol-

lowed presentation of the papers. "Private Flying," by Luis De Florez, consulting engineer, was followed by "Engines for Light Airplanes," by N. N. Tilley, Continental Motors Corp.

More Landing Fields Needed

Although the private plane can be operated on a mileage basis at an equal or less cost than can the automobile, it will never displace the automobile – it will simply add to its range, said Mr. De Florez. The comparison between the automobile and the airplane should not be carried too far, however, he qualified; nor should the operation of motor cars and planes be regarded as similar. Airplane operation calls for "airmanship" which is more nearly comparable to seamanship, and private flying will not really come into its own until we have reared a generation of youngsters who have acquired airmanship, he explained.

Lack of utility and high initial costs of equipment were named by Mr. De Florez as the basic factors retarding the growth of private flying, with a greater number of landing facilities and Government assistance indicated as remedies.

When we consider that there are 9000 private planes and 14,000 private pilots as against 500 scheduled transport planes and 1000 pilots, it does not seem right that private flying has been neglected by the Government, pointed out Chairman Geisse. This is the only country that does not subsidize private flying, which probably is the reason why we lag far behind in this important branch of aviation, he continued.

First of several enthusiastic private flyers to discuss Mr. De Florez' paper was Dr. Daniel P. Barnard, Standard Oil Co. (Ind.) who expressed the opinion that he expected the new small engines to give a real boost to private flying. When it is realized that an airport is unnecessary – a large flat field will do – and that we don't have to use aviation gasoline, private flying will start to grow rapidly, he pointed out. Several of the homes that I visit in my plane have fields beside them that are ideal for landing, he explained.

It doesn't take a superman to learn to fly, contributed Harold H. Brown; all you have to do is to learn to glide and you are safe even if the motor dies. I am a private flyer for only one reason – the fun I get out of it, he announced.

One factor mentioned by Mr. De Florez as holding back private flying is very disturbing – its lack of utility, said Fred E. Weick, Engineering & Research Corp.; it would help the industry if it could be made more useful. Mr. Weick also suggested that any developments that would make planes easier to fly should make it easier and quicker for would-be private flyers to learn to fly, and thus stimulate the industry.

To make private flying more useful, T. P. Wright, Curtiss-Wright Corp., suggested that a four-place private plane to carry an entire family may be necessary. Anything that increases safety of the planes, such as the tricycle landing gear developed by the Bureau of Air Commerce, should help private flying, he concluded.

Better Engines for Light Planes

The increasing yearly sales of light airplanes have been made possible by the improvement in life and dependability of small engines, and are evidenced by the number of new small powerplants on the market this year, according to Mr. Tilley, the second speaker. To obtain low prices many of the earlier designs were based on the use either of automobile or motorcycle engines or their parts, he reminded, drawing attention to the limitations of such engines and parts for the requirements of aircraft service.

By a light airplane, Mr. Tilley explained, I refer to one that weighs between 600 and 1000 lb. gross including two persons and light baggage, that has landing speeds below 40 m.p.h., cruising speeds between 70 and 90 m.p.h., and top speeds between 85 and over 100 m.p.h., and that can travel 25 miles per gal. of gasoline.

Small engines for these planes weigh from 120 to 165 lb. and give 35 to 50 b. hp. at 1900 to 2700 r.p.m., he specified. As a partial explanation of their high (3 to 4 lb. per hp.) weight-power ratio as compared with that of large engines, Mr. Tilley pointed out that the demands for low cost of these small powerplants minimize the amount of finish-machining possible; point to the use of cast iron for cylinders, tappets, and crankshafts; and necessitate accessories of disproportionate weight.

A discussion of design features and performance characteristics of specific engines concluded Mr. Tilley's presentation.

Transoceanic Flying Session

F. W. Caldwell, *Chairman*

JUST what large flying boats can and cannot be expected to do was put before this session in a straight-from-the-shoulder discussion of the "Operating Characteristics of Large Seaplanes," by W. K. Ebel, Glenn L. Martin Co. The practical side of the seaplane transport picture – the hundreds of detailed considerations so essential to success – was outlined in the second paper: "Practical Aspects of Transocean Flying," by C. H. Schildhauer, Pan American Airways.

Flying Models Aid Development

The full development of flying scale models of projected aircraft designs for testing has tremendously important and far-reaching economic aspects, believes Mr. Ebel, discussing the experience of his company with the new method. In his absence, Mr. Ebel's paper was read by Robert Nightingale of the same company.

By eliminating the necessity for building a full-scale prototype for testing and checking design features, he pointed out, a tremendous saving in time and money can be effected.

"The flying-boat designer must disregard the general impression that water craft enjoy the use of practically unlimited take-off and landing areas," said Mr. Ebel. Current operating experience and projected plans show that flying boats in future commercial operations must very often take off and land in restricted harbors, usually busy with water-borne traffic, he continued, and in which a constant vigilance must be maintained for floating debris. Take-off distances and times, therefore, must be much the same as with landplanes until catapults or other means of launching come into general use, Mr. Ebel stated. To avoid obstructions that appear suddenly in the take-off path, such craft must be capable of changing direction rapidly while traveling at high speed on the water, he concluded.

Examining the trend in flying-boat design toward narrow hulls and increased beam loadings, Mr. Ebel called attention to the improved air performance of this design, explaining that the narrower hull still provides adequate space for passengers and cargoes, and that the increased depth of these hulls increases passenger comfort by providing satisfactory headroom on two decks.

On the subject of "porpoising," Mr. Ebel frankly admitted that there was much to be learned in diagnosing the cause and effecting a cure for this undesirable action. Said he: "Little information has been available to guide the designer in developing a combination which, under all wind and wave conditions, is free from this fault. If the designer of a flying boat that is free from 'porpoising' believes that this desirable characteristic has been attained by anything more tangible than extreme good fortune, I invite him to come forward

with his solution. . . . I draw this rather disturbing conclusion primarily as a challenge to research."

Dramatic motion pictures of the construction and flight-testing of the 62,000-lb. flying boat built for Russia, the Martin M-156, followed Mr. Nightingale's reading.

Recent increases in beam loadings, as reflected in higher take-off speeds, seem to give flying boats an advantage over landplanes, believes Dr. J. C. Hunsaker, Massachusetts Institute of Technology. On the other hand, he pointed out, the adoption of pressure cabins may necessitate a change in this construction and troubles in the water also seem to compensate for this advantage of flying boats.

On the subject of "porpoising," Dr. Hunsaker reported that the Germans agree with Mr. Ebel, as a result of studies made with models, that the elimination of this characteristic seems to be a matter of luck.

The difficulties of take-off for large flying boats discussed by Mr. Ebel emphasize the probable necessity of resorting to assisted take-off in the not-too-distant future, reasoned T. P. Wright, Curtiss-Wright Corp., reading from prepared discussion.

Water Patrols Needed

Cities that desire to enter into the international air-transportation field must provide complete flying-boat operating facilities, pointed out Mr. Schildhauer. These facilities, he specified, should include adequate water areas for take-off and landing, terminal facilities to handle cargoes, and passenger accommodations.

Water areas should be restricted as to the height of nearby obstructions and as to water traffic by an airport patrol set up to coordinate the operations of surface craft and aircraft, he urged. Such a system is needed especially at night, he pointed out.

Europe will soon be but a day and a night distant – and later just an overnight journey – in 100-passenger non-stop flying boats whose compression-ignition engines will carry them over 300 m.p.h., he predicted. The salutary effect on international relations of such service cannot be underestimated, as quicker communication and transportation beget good will, he explained. Discussing passenger accommodations:

"The handling facilities at the main terminals must include adequate landing floats to enable passengers to step off directly from the flying boat to the Customs enclosure and be cleared by the government officials. These facilities must be arranged to expedite the removal of cargo in the form of passengers, baggage, mail, and express.

"The requirements outlined in the foregoing apply chiefly to terminals for it would not be economical to provide all of them at all intermediate points. But at every place where a landing can be made, conditions of currents, waves and winds affect operations."

Speaking of seaworthiness, Mr. Schildhauer said:

"Operating areas in the vicinity of flying boat bases usually have a certain condition or state of sea and swell affecting the take-off and landings. The question always has been asked: 'What kind of a sea and swell can flying boats operate in?' It might be of interest to define these terms. The characterization of waves is divided into two general terms, sea and swell; sea, the waves under the impulse of prevailing wind; and swell, the undulations traveling from a distant disturbance. Thus far, there is no definite means of measuring either sea or swell and, as a result, engineers have been at a loss to define, in scientific terms, the ability of the various types to operate in various areas due to lack of adequate information, except by actual operation with its attendant risk of damage. A scientific basis for such measurements adopted internationally would be of great assistance by making possible comparisons between observations made by various agencies in all parts of the world."

Continuing on transocean weather:

"One of the basic distinctions in transocean air transport operations is the significant fact that transocean aircraft do not fly 'routes' in the widely accepted use of that term to designate an airway course. Modern long-range transport operation assumes aircraft adequate to the range requirements of the entire ocean area under consideration. The aircraft, therefore, is capable of flying with a minimum of 30 per cent reserve mileage between a number of intermediate terminals or stations which may be utilized in a single ocean crossing. Despite the talk which has extended over a number of years concerning the different routes, few realize that there is no transatlantic route as such between the United States and Europe any more than there is a transpacific route between California and the Hawaiian Islands. This basic difference is brought about by the fact that in long-range transport operation the flying map used to direct the course of the aircraft is not a route map but a weather map. The actual course is plotted not in terms of the terrain below, but in terms of the pressure areas extending over the entire area to be flown."

Blind-Flying with Skunks and Birds

An interesting sidelight on the blind-landing situation came during Mr. Metcalf's talk at the Aircraft Session. We get all kinds of suggestions at the Bureau, he said. One correspondent wanted to cross homing pigeons with parrots and use the offspring to tell airplane pilots how to get home. Another correspondent, endeavoring to simplify blind flying, said:

"Put a box of skunks in the airport with a small boy and a stick to stir them up. Then just fly by nosing into the prevailing wind."

Applications Received

(*Continued from page* 25)

Pittsburgh Section

BEATTY, JOSEPH M., 451-55 Melwood, Pittsburgh, Pa.

EBERLE, WILLIAM F., manager, oil division, Dauler Benzol Division, The Neville Co., Pittsburgh, Pa.

MARTIN, RALPH V., lubrication engineer, American Oil Co., Pittsburgh, Pa.

ROBIN, ARTHUR, International Harvester Co., Pittsburgh, Pa.

WALDSCHMIDT, EDWARD K., metallurgical engineer, Jones & Laughlin Steel Corp., Pittsburgh, Pa.

Southern California Section

GAMSU, SIDNEY M., engineer, Douglas Aircraft Co., Santa Monica, Calif.

ROWLEY, ROBERT E., Department of Water & Power, City of Los Angeles, Los Angeles, Calif.

Wichita Section

HARDEE, SAM W., vice-president, Universal Motor Oils Co., Wichita, Kan.

Foreign

BERTHELIUS, TOR, civil engineer, Aktiebolaget Volvo, Pentaverken, Skovde, Sweden.

HEILBRONN, LEON, engineer, Les Huiles Orange, St. Denis (Seine), France.

RIETHMULLER, MARVIN, garage foreman, Toowoomba & South Western Motor Co., Ltd., Toowoomba, Queensland, Australia.

Outside of Section Territory

BORNSTEIN, HYMAN, director of laboratories, Deere & Co., Moline, Ill.

CRANMER, RALPH R., assistant junior experimental engineer, Aviation Mfg. Corp., Lycoming Division, Williamsport, Pa.

About SAE Members:

Eugene Gruenewald has been elected president of the Ross Gear & Tool Co. Mr. Gruenewald has been a company executive for the past 15 years. Prior to his election to the presidency he was vice-president and general manager.

Arthur F. Milbrath, chief engineer of Wisconsin Motor Corp., has been elected a director and vice-president.

W. H. Beal has been elected president of Aviation Manufacturing Corp. Mr. Beal was associated with Lycoming from 1919 to 1936,

W. H. Beal
Elected President

serving as president after 1931. Recently he has been associated with the New York Shipbuilding Corp.

Ralph E. Flanders, president, Jones & Lamson Machine Co., has been made a director of the National Shawmut Bank of Boston.

Harry T. Woolson, SAE Past-President, executive engineer, Chrysler Corp.; *Dr. E. J. Abbott,* president, Physicists Research Co.; *A. H. d'Arcambal,* consulting engineer, Pratt & Whitney Co., and *Ralph E. Flanders,* president, Jones & Lamson Machine Co., participated in the program of the American Society of Tool Engineers' annual convention held last month in Detroit.

J. L. Dilworth, formerly junior engineer, experimental department, Packard Motor Car Co., Detroit, is now affiliated with the Virginia Electric & Power Co., Richmond, Va.

Named to Standards Committee

When the Council met in New York on March 7, it approved the following appointments to divisions of the SAE Standards Committee:

Capt. Paul H. Kemmer, assistant chief, aircraft bureau, United States Army Air Corps, Materiel Division, Wright Field, to the Aircraft Division;

R. M. Riblet, Timken Roller Bearing Co., to the Roller Bearings Division;

Hyman Bornstein, Deere & Co., to the Iron and Steel Division.

The Council also approved the appointment of C. M. Larson, Sinclair Refining Co., to serve as SAE representative on the Sectional Committee on Preferred Numbers, which is functioning under procedure of the American Standards Association.

A. G. Herreshoff, chairman of the SAE Engineering Relations Committee, has been appointed to serve as the Society's representative on the Liaison Committee between the Automobile Manufacturers Association and the American Association of Motor Vehicle Administrators. His appointment was confirmed at the March meeting of the Council.

Chester S. Ricker, technical counsel, McCann-Erickson, Inc., in Detroit, has been appointed chairman of the power boat race committee of the Detroit Yacht Club.

A. G. Marshall, assistant refinery manager, Shell Oil Co., Martinez, Calif., visited SAE headquarters while in New York last month. He is a past-chairman of the Northern California Section.

F. Landgraf has joined the Northrop Division of Douglas Aircraft Co., Inglewood, Calif., as engineer in the stress department. He was previously chief engineer of Lewis American Airways, Inc., Denver, Colo.

Henry Butler Allen, secretary and director of The Franklin Institute, Philadelphia, recently was awarded the honorary degree of Doctor of Science by Temple University.

Rear-Admiral Emory S. Land, retired chief of the Navy's Bureau of Construction and Repair, recently was named chairman of the

Photograph by Backrach

Emory S. Land
Heads Maritime Commission

United States Maritime Commission as successor to Joseph P. Kennedy, now Ambassador to Great Britain.

O. P. Wilson, vice-president of the Norma-Hoffmann Bearings Corp., has been elected a director of the Stamford Trust Co., Stamford, Conn.

F. L. Eberhardt, president of Gould & Eberhardt, has been visiting the Leipzig Fair in Germany.

Etienne Ploix has been appointed chief test engineer of the Societe Nationale de Construction de Moteurs, Paris, France. He was formerly chief engineer, motor service, Air France, Paris.

Frank G. Gardner, for nine years chief engineer and vice-president of Breeze Corporations, Inc., of Newark, N. J., is now associated with the Bendix Corp., Scintilla Division, at Sidney, N. Y.

George Hanson has joined Walt Disney, Ltd., Los Angeles, as design draftsman, engineering department. Before this move he was engineering assistant to the manager of the road machinery division, Southwest Welding & Manufacturing Co., Alhambra, Calif.

Edward S. Lemon is assistant job analyst at the Auburn plant of the Central Manufacturing Co., Connersville, Ind.

S. R. Thomas has been appointed chief engineer of Bantam Bearings Corp., South

S. R. Thomas
Chief Engineer

Bend, Ind. For the past year and a half he has been manager of the automotive bearing division, coming to Bantam after an association of four years with the Cord interests as chief engineer of Auburn, Cord and Duesenberg.

Austin M. Wolf addressed high school seniors and graduates on automotive engineering at the third Career Conference, held in New York, March 11 and 12. The meeting was under auspices of the Vocational Service for Juniors. Dr. James Rowland Angell, president emeritus of Yale University, was chairman.

Edward M. Greer, formerly in the aircraft engine division of Continental Motors Corp., Detroit, is now in the engineering department of Douglas Aircraft Co., Santa Monica, Calif., as designer of hydraulic controls.

L. P. Saunders, chief engineer, research division, Harrison Division of General Motors Corp., has been appointed a member of the American Society of Heating and Ventilating Engineers' technical advisory committee on "Heat Transfer of Finned Tubes with Forced Air Circulation."

Harry D. Goldstein is propeller engineer with the Aviation Manufacturing Corp., Williamsport, Pa. He was previously at the Naval Aircraft Factory, Philadelphia, as junior aeronautical engineer.

W. B. Todd
To London

William B. Todd, former vice-president in charge of sales of the Jones & Laughlin Steel Corp., Pittsburgh, sailed early last month for London where he will represent the Steel Export Association of America.

Nelson B. Nelson is district representative for the National Motor Bearing Co. of Oakland, Calif. His headquarters are in Milwaukee, Wis.

. . . . At Home and Abroad

In Australia

A. R. Code, president of the Institution of Automotive Engineers, Australia, and John Sonnerdale, managing director of Sonnerdale, Ltd., foreign members of the SAE, addressed the 1938 Automotive Engineering Convention of the Institution of Automotive Engineers, Australia, held in Sydney, March 7-12.

George W. Wolf, assistant general manager, General Motors Export Division, was official SAE delegate to the convention. James Fielder, Australian member of the SAE Overseas Relations Committee, was the Society's local representative.

Walter N. Deisher, Fleet Aircraft Ltd., Fort Erie, Ont., recently returned from a four-month business trip to New Zealand.

John Burt Flynn, formerly garage superintendent, J. Kitchen & Sons, Pty., Ltd., Sydney, Australia, is now in England as aircraft engineer for Short Bros., Ltd., at Rochester, Kent.

Harold V. Nutt, formerly vice-president of the U. S. Diesel Corp., Allston, Mass., is now located at the United States Naval Engineering Experimental Station, Annapolis, Md., as mechanical engineer specializing on Diesels.

H. V. Nutt
Makes Change

With the original notice of this change in the March SAE JOURNAL, *a photo of Harold Nutt, director of engineering, Borg & Beck Division, Borg Warner Corp., was erroneously used.*

Francis P. Shapiro is representing the Bi-Metal Ring Corp., New York, as district sales manager. He was formerly in the sales department of General Automotive Electric Co.

Harry A. Kurtze, formerly mechanical engineer with the A. O. Smith Corp., Milwaukee, has taken a similar position with E. J. Longyear Co., Minneapolis.

SAE Members Invited to Overseas Conferences

London, Glasgow and Berlin will be hosts to three international technical conferences that members of the SAE are invited to attend.

The first will be in London, May 23-25. The Institution of the Rubber Industry is sponsoring a Rubber Technology Conference which will put particular emphasis on methods of improving and evaluating the durability of rubber. Raw materials and methods of producing various rubber products are among other subjects to be discussed.

From June 21 to 24 an International Engineering Congress will be held in Glasgow, Scotland, as a part of the huge Empire Exhibition which is taking place there from May to October of this year.

Berlin will be the scene of the International Technical Education Congress sponsored by the Bureau International de l'Enseignement Technique. The dates of the Congress are July 25-29.

Members of the SAE who will be abroad this summer and would like to attend any of these conferences may obtain further details from the Society's headquarters at 29 West 39th Street, New York City.

S. B. Springer, who has been in Monrovia, Liberia, West Africa, as automotive superintendent, Firestone Plantations Co., is now located in Cleveland, Ohio, as automotive engineer with the Fidelity Casualty Co. of New York.

S. B. Springer
Back from Africa

John L. Coltman has joined Caprotti Valve Gears, Ltd., London, England, as locomotive engineer. He was previously in Manchester as draftsman with Nasmyth, Wilson & Co., Ltd.

I. B. Morgan has joined the technical sales staff of the Black Gold Oil Co., Denver, Colo. He was formerly vice-president in charge of oil sales, Moto Royal Oil Co., also of Denver.

John W. Hobbs is president and general manager of the recently formed John W. Hobbs Corp. of Springfield, Ill. The company will be devoted to manufacture of automotive parts and accessories. Mr. Hobbs was previously vice-president and general manager of the George W. Borg Corp., Chicago.

Lieut. H. Knox Perrill, engineering officer, United States Navy, who has been connected with the Fleet Air Detachment, Naval Air Station, San Diego, is now doing experimental work on aircraft engines at the Naval Aircraft Factory, Navy Yard, Philadelphia.

H. A. Hansen
Twenty-Fifth Anniversary

H. A. Hansen, manager of the marine carburetor division of the Bendix Products Corp., last month completed 25 years of service in the marine industry. Starting with the Stromberg Motor Devices Co. in 1913, he has been affiliated with it and its successor company ever since. He was appointed to his present position in 1931.

Alfred Hodgson is service manager, San Fernando district, for Neal & Massey Engineering Co., Ltd., Port of Spain, British West Indies. He was previously maintenance engineer for Trinidad Leaseholds Petroleum Refinery, Trinidad, B. W. I.

Yoshi-Aki Murakami, former director of Automobil Industry, Ltd., Tokyo, Japan, is now affiliated with Tokyo Jidosha Kogyo K.K., also in Tokyo.

Kettering and Breer Speak

When the American Institute of Physics held its symposium on Physics in the Automotive Industry, with cooperation of the department of Physics, University of Michigan, at Ann Arbor, March 14 and 15, C. F. Kettering, director, General Motors Research Laboratories, gave the principal address. His subject was "Scientific Training and Its Relation to Industrial Problems." Carl Breer, executive engineer, Chrysler Corp., spoke on "Needs of the Automotive Industry for Fundamental Scientific Research."

William F. Little, Electrical Testing Laboratories, is the Society's representative on a committee being formed to study possible means of adapting bituminous pavement surfacings to improve highway seeing after dark.

J. R. MacGregor, research engineer, Standard Oil Co. of California, has changed his office from Richmond, Calif., to San Francisco.

Harry Dickson has joined General Motors Products of Canada, Ltd., as district service manager in the Regina division. He was previously service manager of Regina Chevrolet Sales, Ltd.

J. K. Townsend, former machine designer with the National Broach & Machine Co., Detroit, is now in England as gear designer, with Charles Churchill Co., Ltd., South Yardley.

About Authors

(*Continued from page* 11)

● **Hampton H. Foster** ***has been engaged in research on the high-speed compression-ignition engine at the National Advisory Committee for Aeronautics at Langley Field, Va., since graduation from George Washington University in 1927.***

● **J. L. S. Snead, Jr.,** ***superintendent of operations, Consolidated Freight Lines, Inc., has been with that company since the spring of 1930. He attended Stanford University and is a member of the National Association of Purchasing Agents and of Technical Committee F on Diesel Fuel Oil of the American Society for Testing Materials.***

● **Macy O. Teetor** ***(M '24) was born in Hagerstown, Ind. After two years of engineering at the University of Pennsylvania he decided that his opportunity was greater in general business. He received his B.S. degree in Economics from the Wharton School of Commerce, University of Pennsylvania, in 1923. He joined the executive sales force of the Perfect Circle Co. after graduation and became a director of the company. His general bent for engineering, however, shifted him from sales to factory manager and then to executive engineer.***

● **Ernest G. Whitney** ***(S.M. '37) was graduated from the School of Engineering of the Johns Hopkins University in 1927 and has been employed since that time by the National Advisory Committee for Aeronautics at Langley Field in two- and four-stroke-cycle Diesel and gasoline engine research, with particular attention to the Diesel problem. For the past 3 years Mr. Whitney has served as head of the Committee's engine-research section.***

News of the Society

(*Continued from page 24*)

congratulating the Kansas City Section on its fine program, briefly discussed the activities of the Society during the past year. He also spoke of advantages of membership in the SAE.

The final paper of the meeting, "Engine Deposits," was presented by C. M. Larson, chief consulting engineer, Sinclair Refining Co.

The author explained that the engine deposits with which operators are concerned have their source in what is commonly called sludge. This is composed of carbonaceous matter (either from blowby or from high-temperature cracking); asphaltenes (oxidized oil products); ash (mostly lead oxide and iron bromide where gasoline is used, metals from wear and corrosion, and dust from the air), and moisture from condensation, he said. Mr. Larson also noted that these component parts of sludge vary greatly depending upon engine design, operating conditions, fuel and lubricant used.

The problem, he said, is for the engine designer to stay within the limits of the organic compounds (lubricating oils and fuels) and the operators to stay within the limits for which their equipment was built. Then, he declared, with the proper selection of fuels and lubricants, engine deposits can be controlled to a minimum.

Speaks on Opportunities In Motor-Transport Field

● **Oregon State**

Stressing that students planning to enter the motor-transport field must be business men as well as engineers, Harley W. Drake, superintendent of equipment, Pacific Highway Transport, spoke on "Motor-Truck Transportation" before the March 4 meeting of the Student Branch at Oregon State College. All O.S.U. engineering students were invited.

Mr. Drake emphasized the importance of engineering in the motor-transport field. He discussed the many difficulties encountered in operating a fleet of trucks on a competitive basis and covered the financial, personnel, maintenance and operation phases of truck transportation.

Following the open meeting Mr. Drake spoke to the SAE student members at a short business meeting, urging them to participate in the Student Paper Contest being sponsored by the Oregon Section. It is an opportunity, he said, for displaying abilities developed in college work.

Blames Heat for Most Bearing Failures

● **Northwest**

Stating that excessive temperature is by far the most common cause of bearing failures, R. A. Watson, service engineer, Federal-Mogul Corp., told members and guests attending the Feb. 4 meeting of the Northwest Section that the most effective method of holding bearing temperature down is to circulate sufficient oil through the bearings.

Great care should be exercised, he said, to allow sufficient oil clearance in fitting. When assembling modern insert-type bearings it is necessary to have the rod and cap absolutely clean before installing the insert, he declared, as any small particle of carbon, metal or other foreign substance will cause a high spot on the bearing when the cap is drawn down. This, he explained, will result in loss of oil clearance at that point, with subsequent overheating and failure of the bearing material in the area affected.

Failure to allow sufficient end-clearance in fitting a bearing will result in the vehicle breaking down before it reaches the city limits, he declared.

Car Buyers Not a Static Group, Neely Declares

● **Detroit**

"We are selling cars to a parade, not to a static crowd," W. H. Neely, chief design engineer, Graham-Paige Motors, Inc., declared in discussing the mechanics of automobile-body styling, design and production engineering at the February 21 meeting of the Detroit Section. To emphasize this point he spoke of the radical designs youthful competitors entered in a recent model contest, stating: "We must not forget that these youngsters will be our automobile prospects in a few years."

"Presenting a paper on this subject before engineers and designers is truly bringing coals to Newcastle," Mr. Neely said, adding, "but there is compensation in the hope that we may possibly have arrived at our destination by a detour or two which can be avoided by others in attacking their problems." He then gave a graphic description of the procedure followed in the design of the 1938 Graham, illustrating with slides how a shaded mass on a sheet of paper was developed into a product to symbolize "the spirit of motion in automotive transportation."

After paying tribute to the late Amos Northup as having initiated the design, and to Leonard Keller who aided in completing the work, Mr. Neely told how the chassis, body and design engineers first analyzed every available piece of information that would help in planning their program. Of public taste, he said: "Customer preference indicated that a car without a trunk would be seriously handicapped in the race for sales. . . . Automobile customers always remember the wheelbase and horsepower of the cars they look at."

Mr. Neely showed slides to illustrate the technique of transferring ideas to the drawing board, thence to quarter-scale sculpture, full-size blackboard drawings, wooden scale models, and finally the blueprint stage. He illustrated how compromises are effected to bring design and functional necessity together.

Mr. Neely touched upon the probability of important changes in the future, such as rear-mounted engines. He complimented William B. Stout on his Scarab car, declaring that objections to radical changes are being rapidly overcome by current developments, including the reduction of weight per horsepower in engines.

Frank Coates, production engineer, Fisher Body division, General Motors Corp., added to Mr. Neely's talk some of the ideas and ideals of the men who convert new designs from drawings to actuality.

Tire Paper Discussion Centers on Retreading

● **Pittsburgh**

SAE President C. W. Spicer and General Manager John A. C. Warner were welcomed as guests of honor by more than 100 members and friends of the Pittsburgh Section on March 15. Following the dinner and a short business meeting Section Chairman Ralph Baggaley, Jr., introduced Mr. Warner, who in turn introduced Mr. Spicer. Mr. Spicer took as his subject, "New Firing Lines for Engineers."

Leland W. Fox, sales engineer, Firestone Tire & Rubber Co., was speaker at the technical session, reading the paper "What Fleet Operators Should Know About Tires." This was presented by J. E. Hale at the SAE Annual Meeting and is printed in full in the TRANSACTIONS SECTION of the March SAE JOURNAL, pp. 101-117.

George W. Brisbin, secretary of the Pittsburgh Section, opened the discussion by asking what tests can be used to determine whether tire casings are worth retreading. Mr. Fox replied that an examination by an experienced inspector is the only feasible method.

In explaining the difference between retreading and recapping, at the request of J. A. Harvey, Pittsburgh Motor Coach Co., Mr. Fox stated that retreading involves the removal of all old rubber from tread and shoulders down to the fabric. Recapping, he said, means roughing up tread and rounding off shoulders and replacing in mold or matrix to have new tread-pattern applied. He added that recapping is most generally applied to truck tires where the tread wears more rapidly than the fabric.

It was reported by Mr. Sanford that in western Pennsylvania recapping costs 10 or 15 per cent less than retreading. He stated that both give satisfactory service when work is well done.

On the relative merits of dual and single tires for truck service in soft going, a question brought up by Mr. Baggaley, it was pointed out that duals tend to pile up mud in front of the tires so that, in some cases, singles are preferred – providing that singles have enough flotation for the roads upon which they are used. In oil field work, it was stated, 1½-ton trucks use four tires on each side of the rear axle to give greater flotation on very soft roads.

Answering a question by Murray Fahnestock, the speaker stated that at present prices rayon-fabric tires are justified when trouble results from overheating, noting that at 250 deg. fahr. the strength of cotton is 30 per cent less than that of rayon. Responding to a question asked by F. E. Haller, Mr. Fox stated that tire temperature is affected by load, atmospheric temperature, and under-inflation or flexing. The latter, he said, is generally the most important factor.

Officers and Council Guests of Section

● **Metropolitan**

President C. W. Spicer and members of the SAE Council were guests of the Metropolitan Section at its regular dinner-meeting March 7. Lowell Thomas, radio commentator and author, and William L. Batt, president, SKF Industries, Inc., were the principal speakers on the program arranged by E. E. Husted, the Section's meetings chairman. Mr. Spicer, Ralph R. Teetor, past-president, A. T. Colwell, a vice-president, and David Beecroft, treasurer, spoke briefly in discussing Mr. Batt's address, "Business and Government."

Engineers and business men alike were called upon by Mr. Batt to consider the business of government *their* business, and to keep in touch with their senators and representatives on legislative matters in which they have some concern.

"We cannot expect to see solutions to national problems if we continue to think of legislators as a class of men set aside from us. If we fail to show them our personal and community interests from time to time, I don't believe this world of ours will be a fit place in which to live," he said.

"I believe the engineering profession will accept this vital challenge to a larger degree, perhaps, than any other group," he concluded.

Two Student Branches Elect New Officers

Due to the recent resignation of John B. Reese as chairman of the New York University Student Branch, an election was held in which Noel C. Menzl, Jr., was elected chairman; Johan H. Bouman, vice-chairman, and James R. Chapman, secretary-treasurer.

At Ohio State University Student Branch

officers elected for the winter quarter were Robert E. Clark, chairman; Harry D. Coe, vice-chairman; Richard Langhorst, secretary, and Jerome Scerba, treasurer.

Student Branch Holds Two February Meetings

● Ohio State

During February the Student Branch at Ohio State University held two meetings which were well attended by members and other upper classmen in the mechanical engineering department.

On Feb. 18 a representative of the Chevrolet Motor Co. presented four moving pictures showing construction of the new Chevrolet clutch, development of new body styles, engine lubrication and various means of traffic control with special emphasis on the control of traffic signals.

Prof. Harold W. Bibber, of the O.S.U. electrical engineering department, addressed the Student Branch on Feb. 25. He spoke particularly of his experiences while traveling in Japan and Europe as a representative for a large electrical company.

With others of the mechanical engineering department, members of the Student Branch attended a special demonstration of the Ethyl Gasoline Corp. Clinic on March 1.

Motor Truck Rating Committee Reconstituted

Reconstitution of the Motor Truck Rating Committee was authorized by the Council at its meeting in New York on March 7. The Council acted on a recommendation of the Engineering Relations Committee which pointed out that the proposal that vehicles operating on grades of X per cent, or less, be required to maintain a minimum speed of Y m.p.h., is receiving increasing consideration.

The reconstituted committee will continue its work on truck ratings and in addition will undertake a study of the automotive engineering problems which such a legal minimum performance requirement and its enforcement would present. In general terms, the objective of this study will be to develop sound engineering bases for rating motor-vehicles, particularly with respect to their ability to meet a legal minimum performance requirement and/or for methods of measurement to determine compliance with such requirement on the highway.

Section Holds Student Meeting on College Campus

● Milwaukee

Automobiles of today are superior to those of the 1890's because of research, T. A. Boyd, head of the fuel department, research laboratories division, General Motors Corp., said before the March 4 meeting of the Milwaukee Section which was held on the campus of the University of Wisconsin. When the first cars were made, he continued, all the necessary elements from carburetors to differentials were with us, so there has been no true invention since then. Research, he declared, has taken these same elements and by steady improvement has rapidly made the motor car a necessity.

This meeting was planned as the first of a series to bring members of the Section in closer contact with future engineers, and many students from the University of Wisconsin and Marquette University attended. President Dykstra of the University of Wisconsin said, in his address of welcome, "The University needs contact with the SAE." He further remarked that the Society has furnished men who have solved many problems connected with the automotive industry – and that in the present important problem of getting all men in industry to work together, the world could do well to study how automotive engineers work out their solutions.

In speaking of the future Mr. Boyd said that research will have to be along lines more closely related to pure science. He emphasized that much remains to be done and told the students that it will be their job to do it.

Among the aims of future investigation Mr. Boyd included: making lighter metals more abundant; making iron rust proof; developing much lighter engines; providing better lighting for night driving; producing a flexible safety glass; seeking a better understanding of lubrication and a better knowledge of combustion, so that leaner mixtures can be used.

In conclusion he emphatically denied accusations that the automotive industry shelves good ideas because of not wanting to upset current practice. On the contrary, he declared, the industry is constantly on the lookout for new ideas.

Following Mr. Boyd's presentation Prof. G. C. Wilson, who made arrangements for the meeting, called upon students of the two colleges who had prepared discussion of the paper.

Many members of the Section arrived at the University early in the afternoon and had the opportunity of inspecting the new engineering building and seeing the students at work on experiments and tests in the laboratories. Dinner was served in Tripp Commons, dining room of the Wisconsin Memorial Union.

What Foreign Technical Writers Are Saying

AIRCRAFT

Hydro- and Aero-Dynamics

By S. L. Green. Published by Sir Isaac Pitman & Sons, Ltd., London, 1937. 166 pp. [A-1]

The author, a lecturer in mathematics at Queen Mary College, University of London, describes the volume as a theoretical textbook for advanced students of aeronautics, hydraulics, physics and mathematics. It is based on courses of lectures given during the past eight years at Queen Mary College and provides an introduction to the theory of the motion of fluids, including modern developments.

Sur les Installations d'Alimentation à Deux Carburants

By Basile Demtchenko. Published in *L'Aéronautique*, October, 1937, *L'Aéronautique* section, p. 113. [A-1]

Airplane fuel feeding systems designed for the use of two different fuels, one for cruising and one for take-off or maximum power, must provide, says the author, automatic separation of the two fuels and assurance of an uninterrupted fuel supply. He described the design and operating principles of a number of layouts that have been tested in the laboratories of the Etablissements A. M. These fall into two classes, one in which only one pump, for the cruising type fuel, is used, and the other in which there are two pumps, one for each fuel. The former type is said to be attractive because of its simplicity, but difficult to put into practical operation, and the latter is thought to offer more promise for future development.

Flugzeug-Typenbuch, Ausgabe 1937/1938

Published by Herm. Beyer Verlag, Leipzig, Germany. 636 pp.; illustrated. [A-3]

The supplementary title of this publication, Handbook of the German Aircraft Industry, better describes its nature than its primary title, Book of Aircraft Models. Design specifications and performance data are included not only for German powered and non-powered aircraft, but also for aircraft engines; propellers; aircraft safety apparatus; flight and navigation instruments; aircraft and engine accessories; electrical equipment; structural materials; testing apparatus for materials, parts and complete engines and aircraft; production tools and machines, and ground equipment. A list, classified according to article, shows the sources of supply of the various items included in the scope of the aircraft industry. Two indexes to the contents of the book are included, one of firm names, the other of names of articles referred to.

This is the second edition of the handbook, the first having appeared in the summer of 1936. Benefiting by the experience and prestige gained by the first attempt, this second publication is more inclusive, and has greater clarity and uniformity of presentation and more detailed classification of subject matter. That the material may be as complete as possible, all data submitted by contributing firms has been reproduced. It is hoped that, in addition to being used as an industrial book, this publication may also serve as a textbook to students.

Le Pilotage Automatique des Avions

By P. Franck. Published in *La Technique Moderne*, Nov. 15, 1937, p. 745. [A-4]

This article on automatic piloting of aircraft defines the objective of such systems, examines the mechanical elements of which they must be composed, reviews the different makes that have been designed, built and tested, emphasizing especially those that are most widely used, and detailing the reasons on which the superiority of the latter is based. Following are the names of experimenters and companies associated with the systems that have not achieved wide usage: Ferrié, Brilloin and Guéritot; Etrévé; Constantin; Gianoli; Boykow and Siemens. The Sperry system, used in this country, and the British Smith system, used both in the country of its origin and in France, are the two distinguished by the most widespread practical application.

From the author's review, he concludes that no system as yet devised is absolutely automatic, that is, makes it possible to dispense with the services of a pilot. However, the more generally adopted systems can conduct long, straight flights at constant altitude without the pilot at the controls, thus relieving him of considerable fatigue.

ENGINES

Fehler an Kraftstoff-Zubringerpumpen für Fahrzeugdieselmotoren in Praktischer Beziehung

By Heinz Fiebelkorn. Published in *Automobiltechnische Zeitschrift*, Dec. 10, 1937, p. 576. [E-1]

To the fuel pump whose function it is to force fuel from the tank through the filter to the injection pump may be traced many operating difficulties of automotive Diesel engines, says the author. In the present practical discussion he describes the design and operation of the Bosch, Deckel and a diaphragm type of pump. He then reports on their delivery characteristics and on the effect on these delivery characteristics of certain defects in the pump itself or in the fuel feeding system, as determined by his laboratory testing set-up.

All pumps were found to have a possible delivery output, in normal operation, much greater than engine fuel requirements. All pumps were found to be very sensitive to any leakage in the fuel piping and recommendations as to the correct installation of the feeding system are given. Partial stoppages in the fuel line and wear of the piston or diaphragm were found to have little effect on delivery characteristics. Decrease in stroke was also found to be of relatively small importance in piston pumps, but to affect the output of diaphragm pumps more decidedly. The effect of poor valve seating is also discussed.

Holzgas-Generatoren

Österreichisches Kuratorium für Wirtschaftlichkeit Veröffentlichung 20, 1937. Published by Julius Springer, Vienna, Austria. 115 pp.; 88 ill. [E-1]

With a third of her territory wooded, Austria occupies fourth rank among the countries of the world in the extent of her forests. Since 1931 a special committee of the Austrian bureau for industrial economy has been stimulating efforts to cheapen the production of wood, improve its transportation and increase its market. Because Austria is poor in other fuels, such as coal and oil, the substitution of wood,

The letters and numbers in brackets following the titles classify the articles into the following divisions and subdivisions: *Divisions*—A, Aircraft; B, Body; C, Chassis Parts; D, Education; E, Engines; F, Highways; G, Material; H, Miscellaneous; I, Motorboat; J, Motorcoach; K, Motor-Truck; L, Passenger Car; M, Tractor. *Subdivisions*—1, Design and Research; 2, Maintenance and Service; 3, Miscellaneous; 4, Operation; 5, Production; 6, Sales.

through the use of gas generators, is an important aim of the committee. Its investigation in connection with motor vehicles led, in 1934, to the pronouncement that the use of wood as internal-combustion engine fuel is technically and economically justifiable.

Small gas generators such as may be used with stationary engines in agriculture and industry were the subject of the present investigation. Government agencies in Austria and interested technical societies in Switzerland and Germany cooperated. Six small gas generators were subjected to a series of comparative tests, with the object of showing the relation between generator design and fuel type. The conclusion drawn is that while the producers are practicable in their present state, they could be improved along lines suggested by the test results. Soft as well as hard wood, and wood even of high moisture content are said to be usable as fuel. Subjects of further research are suggested.

MATERIAL

Prüfung von Lagermatellen und Lagern bei Dynamischer Beanspruchung

By A. Thum and R. Strohauer. Published in *Zeitschrift des Vereines Deutscher Ingenieure*, Oct. 23, 1937, p. 1245. [G-1]

Because of increasing bearing failures in high-speed engines, this investigation was undertaken to determine the causes of the failures and means for preventing them. A testing machine was developed, to ascertain the fatigue strength, under continuous impact, of small test pieces of bearing metal. By means of a second apparatus, which simulated the operating conditions of a connecting-rod bearing, an investigation was made of the effect on bearing life of its installation. In tests on a third apparatus, using actual engine bearings, bearing strength under alternating loads, and the effect on it of temperature, bearing play and thickness were determined. All four operating factors investigated, bearing installation, temperature, play and thickness, were found to have an important effect in producing failures similar to those found in service.

Die Ermüdungsfestigkeit Dünnwandiger Rohre für den Flugzeugbau im Ungeschweissten und Geschweissten Zustand

By Cornelius and F. Bollenrath. Published in *Luftfahrt-Forschung*, Oct. 12, 1937, p. 520. [G-1]

A summary is given of previously published test results on the fatigue strength of welded and unwelded thin-walled tubes of unalloyed and chrome-molybdenum steels, such as used in aircraft construction. Deviations in the results obtained by different investigators are said to be due to variations in the quality of the welding, in the case of the welded tubes.

The most important investigations are said to be those dealing with the effect of heat treatment and the methods of welding on the strength under alternating bending stress of welded chrome-molybdenum steel tubes. Through tempering after welding, the strength under alternating bending stress is greatly increased. With increased starting temperature, the ratio of bending strength to tensile strength is increased. For welded tubes which are not heat-treated, the electric arc process is superior to acetylene welding. Due to incompleteness of the tests cited, a comparison of welding methods for heat treated tubes could not be made.

PASSENGER CAR

Nouvelles Considerations sur les Marchés Automobiles

By J. Andreau. Published in *Journal de la Société des Ingénieurs de l'Automobiles*, November, 1937, p. 523. [L-6]

A mathematical analysis is made to determine the economic laws which must be observed in any attempt to improve general economic conditions, and, for the automotive industry specifically, to bring about a closer adjustment between production and sales and to prevent major periodic crises.

Based on statistics of automobiles in operation in France and in the United States since 1915, a law of growth for the automotive industry is evolved. Production figures are then presented, and the conclusion drawn that production in the past has not been sufficiently well controlled or flexible to maintain a proper relation to sales. Provided present conditions are allowed to persist and no new controlling factors introduced, a crisis is predicted for the American automotive industry for 1939 or 1940, similar to that of 1930-1933; and for the French automotive industry, a decrease in production, by 1942, to 123,000 vehicles a year, with consequent unemployment to about 300,000.

Factors which may alter radically the predicted course are taxes and original and operating costs of automobiles. A reduction in these items in France will, it is said, result in sufficiently increased sales to maintain at its present level the total revenue to the state from the automotive industry, and to keep up production to the point where no unemployment will result. To bring about the technical improvements needed to justify lower original and operating costs, the setting up of a research organization is suggested. Production control, and the allocation to each manufacturer of his share of the annual output are also urged.

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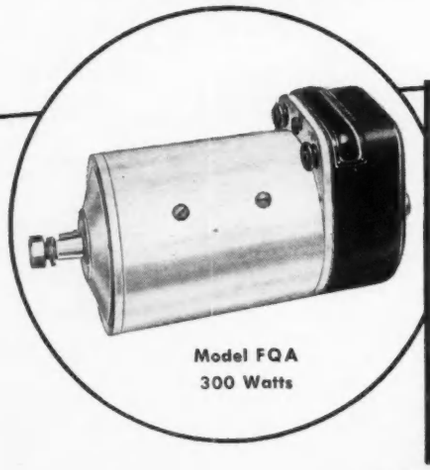

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